# PRECONTACT ARCHAEOLOGY AND PREHISTORY of the Central Montana High Plains

BLM

Montana State Office

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Compiled and Edited by

**Leslie B. Davis**

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.



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Technical Report to the Montana State Office
U.S.D.I. Bureau of Land Management

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# Prologue

Archaeological field projects carried out in central Montana in the 1970s, within the Bureau of Land Management's Lewistown District, led to the discovery and recordation of significant precontact settlement and subsistence activities at three locations in Valley, Choteau, and Musselshell Counties. Federally sponsored fieldwork was necessitated by a federal mandate to identify, study, protect, preserve, and report irreplaceable cultural resources on public lands or within federally managed jurisdictions. The resulting professional investigations ranged in scale and objectives from locating and mapping surface features, potentially threatened by extensive proposed bentonite mining, excavating a "sample" from an eroding, stratified artifact-bearing floodplain (previously dug into by recreationists), in anticipation of intensified public use resulting from pending federal designation of the Upper Missouri National Wild and Scenic River, and a Montana State University instructional initiative to investigate remnant cultural deposits at a vandalized bison kill/occupation site, being actively collected at that time.

Involved in this multidisciplinary research, in addition to archaeologists Les Davis (projects director and principal investigator), Steve Aaberg (field supervisor, lithic analyst), John Darroch (field supervisor), Helen Strickland, Weber Greiser and Michael Wilson (faunal analysts), and Ann Johnson (ceramics analyst), were Susan Curtis (historian) and Robert Ottersberg (geologist/soil scientist). Avocational archaeologists and university students are identified and credited in the respective sections of this volume, as are others who aided crews in the field.

Fieldwork, research, and writing have been concluded over the years, much of the latter gratuitously, with the intention of satisfying the public's need and right to understand the precontact heritage of the Northwestern Plains Region and the State of Montana. The nature, details, and patterns of precontact hunter-gatherer lifeways, elicited by these studies, are of broad public interest.

Leslie B. Davis, Director
Paleo-Mountain Archaeological Research
Montana City, Montana

**Cover:** Artistic rendition of a Northwestern Plains Region Central Montana landscape with native hunters on lookout for bison, by K. L. Mather, Whitehall, Montana, for Museum of the Rockies

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# Natural & Cultural Heritage Resources in the Brazil & Little Beaver Creeks Bentonite Mining Claim Project Area, Southwest Valley County, Montana

*Leslie B. Davis, Stephen A. Aaberg, and Susan W. Curtis*

## Abstract

A comprehensive record search and ground-truth investigation was performed from late summer to early winter of 1976, of federal and state lands within 114 bentonite mining claims under lease by Aurora Metal Company in southwest Valley County, northeastern Montana.[21] The leased area, parts of which would be affected by projected bentonite mining activities, comprises 20,400 acres of weathered upland terrain drained by Brazil and Little Beaver Creeks.

Local geology, geomorphology, and geohydrology reveal that the surface of the study area has been intermittently modified by ongoing erosion; natural effects of disturbance have been aggravated by the disruptive effects of livestock grazing, vehicular traffic, road and railroad construction, and exploration for and extraction of bentonite. Also, artifacts were collected from many parts of the surface, and certain of the surficial features were potted by artifact collectors and inquisitive others prior to the inventory. These agencies of disturbance have combined to create a dynamic and vulnerable landscape in which only 43 percent of the identified cultural heritage sites have escaped degradation.

Three hundred and three separable sites of precontact activity (n= 298) and recent historic activity (n= 5) were inventoried on-the-ground on 102 of the 114 mining claims, between 27 July and 17 August, by a survey team from Montana State University. The inventoried heritage sites represent activities associated with settlement (habitation), food procurement (bison kill/drives), raw material procurement and tool production, and ceremonial systems. Observed archaeological features include: fire-broken rock; hearths; stone circles; rock clusters; cairns; stone piles; drive lines; rock alignments; and surface depressions. Recovered prehistoric artifacts include: projectile points; knives (bifaces); piéces esquillées; end scrapers; edge-retouched flakes; hammerstones; choppers; a zoomorphic stone effigy; lithic waste; and earthenware ceramics.

The 303 heritage sites were evaluated and assigned significance levels (CRES) in accord with established criteria to determine their relative national importance as cultural resources. Four (1.3%) Level 1 prehistoric sites are sufficiently important to warrant nomination to the National Register of Historic Places; however, only three of these sites are recommended for nomination. Thirty-three (10.9%) sites are significant at Level 2, 146 (48.3%) at Level 3, and 120 (39.5%) at Level 4; certain of these sites merit protection.

The effect of bentonite mining cannot be predicted at 215 (71%) of the heritage sites, since these sites occur at distances greater than one-quarter mile from projected pit locations or because pit locations (on state lands) were not specified by the Company. Indirect detrimental effect is anticipated at 70 (23.1%) sites in the study area, with direct impact is predicted at 18 (5.9%) sites. The indirectly affected sites distribute on 42 mining claims, while the directly affected sites occur on 15 claims; both indirectly and directly affected sites are located on 10 claims.

Avoidance of potentially adverse affects on sites is the preferred action alternative. However, since the practicality and feasibility of avoidance as an alternative remains a matter for future determination between the Company and public land managers, recommendations specify the most effective mitigation approach as though each projected pit location will be mined as planned. Further action to preserve and protect affected sites is not required at 239 (79%) of the heritage sites. The mapping of surficial features is recommended at 40 sites, mapping augmented by test excavation at 23 sites, and excavation at one site. Recommended mitigation procedures are appropriate to and contingent upon the circumstances presented by anticipated mining actions at specified locations. Since any future changes in pit location will alter the proximity relationship between identified sites and mined locations, such changes may be cause for a reappraisal of proximity, impact, and the advisability of protective action on the part of the Company.

## Acknowledgments

We wish to thank those members of our investigative teams all of whom surpassed themselves: Marc Smith, who created the the line drawings; Carol Yonkee and Kristie Arrington, who typed the 303 site reports during decathlon sessions; Michelle Sauther, who finalized the sketch maps on the site report forms in Volume II, Appendix B; and Cel Allard, who typed the original version of this report diligently and with characteristic enthusiasm. To John Darroch, Bill Spencer, and Valerie Baker, we express our appreciation for profitably shared hours and thoughts.

We are indebted to Les Reichelt, wildlife biologist with ECON, Inc., Helena, who shared a critical map and introduced us to the intricacies of his inventory work in the study area. Representatives of Federal Bentonite who were performing assessment work during our field effort assisted the crew in times of distress. We also acknowledge the help and information contributed by those individuals who responded to inquiries from Sue Curtis.

Lastly, we are grateful to Bob Carroll, general manager of ECON, Inc, for the periodic assistance that expedited completion of the groundtruthing fieldwork and facilitated the timely delivery of this report to the project sponsor.

David C. Austin proofread the revised 1997 version of the original report to the Aurora Metal Company. The Bureau of Land Management sponsored word-processing by Diane Fuhrman, who gave the project her timely, expert attention.

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# Introduction

## Project Objectives and Contract Specifications

The Aurora Metal Company, Federal Bentonite Division, of 1019 Jericho Road, Aurora, Illinois 60538, is engaged in actions that anticipate the mining of bentonite on claims held by the Company on properties in southwest Valley County, Montana. These leases comprise 8,260 ha in Valley County west and south of Glasgow, Montana, in Townships 27 and 28 North and Ranges 34 and 38 East. About 7,208 ha are owned by the Department of the Interior and administered by the Bureau of Land Management, Lewistown District, and 2,600 acres (1,052 ha) are school sections owned by the State of Montana and administered by the State Land Board (Figures 1). To satisfy existing agency land use and cultural resource preservation regulations of the Bureau of Land Management and to enable the filing of an application for a mining contract with the State of Montana, the Company required a cultural resource investigation of the public lands on which its mining claims are located.

The contractual agreement negotiated between the Company, as sponsor, and Montana State University, as offerer, provided the following work specifications:

(1) Contractor will make an exhaustive effort to identify known and unknown archaeological and historical manifestations on the specified tracts;

(2) Research will entail the examination of existing records, followed by a ground-truth survey;

(3) Selective surface collections will be taken and a photographic record of selected manifestations will be made;

(4) Limited sub-surface testing will be performed, as necessary, but only on state properties;

(5) Data will be presented on standard site report forms, and Smithsonian Institution-type uniform site designation numbers will be assigned to each recorded site;

(6) Identified archaeological and historical sites will be evaluated by reference to criteria in use by the Bureau of Land Management in order that significance determinations can be made systematically, consistent with current practice;

(7) National Register of Historic Places eligibility of each site will be considered and estimated; and

(8) Estimations of direct and indirect impacts, avoidable and unavoidable adverse effects of the mining actions, impact mitigation, and protective recommendations will be made for each site consistent with the nature and importance of identified heritage values.

Other contract stipulations provided that the Contractor would:

(a) Arrange any clearances necessary to enter upon public lands for cultural resource recording and protective purposes and, if necessary, apply for a federal antiquity permit to undertake a surficial reconnaissance of specified BLM properties;

(b) Prepare a report that will meet the intent of all existing land use regulations that pertain to cultural resource preservation, including but not necessarily limited to the following: the Antiquity Act of 1906 (Public Law 59-209, 34 STAT. 225; 16 U. S. C. 431-433); the Historic Sites Act of 1935 (Public Law 74-292, 49 STAT. 666; 16 ASK. 461- 467; the Historic Preservation Act of 1966 (Public Law 89-665, 80 STAT. 915; ASK. 470); the National Environmental Policy Act of 1969 (Public Law 91-190, 31 STAT. 852; 42 U.S.C. 4321-4347); Executive Order 11953; Archaeological Conservation Bill (Public Law 93-291); and the Montana Antiquity Act of 1974;

(c) House all collected specimens and records produced by this investigation in archaeological collections maintained and curated at Montana State University;

(d) Perform the work pursuant to this agreement under the direction of Leslie B. Davis, Ph.D., Associate Professor of Anthropology, Department of Sociology; and

(e) Present one (1) preliminary review copy of the final report, as described above, to Ecological Consulting Services, Inc., the Company's ecological consultant, by 30 November 1976; six (6) copies of the final report would be delivered to ECON, Inc. by 31 December 1976.

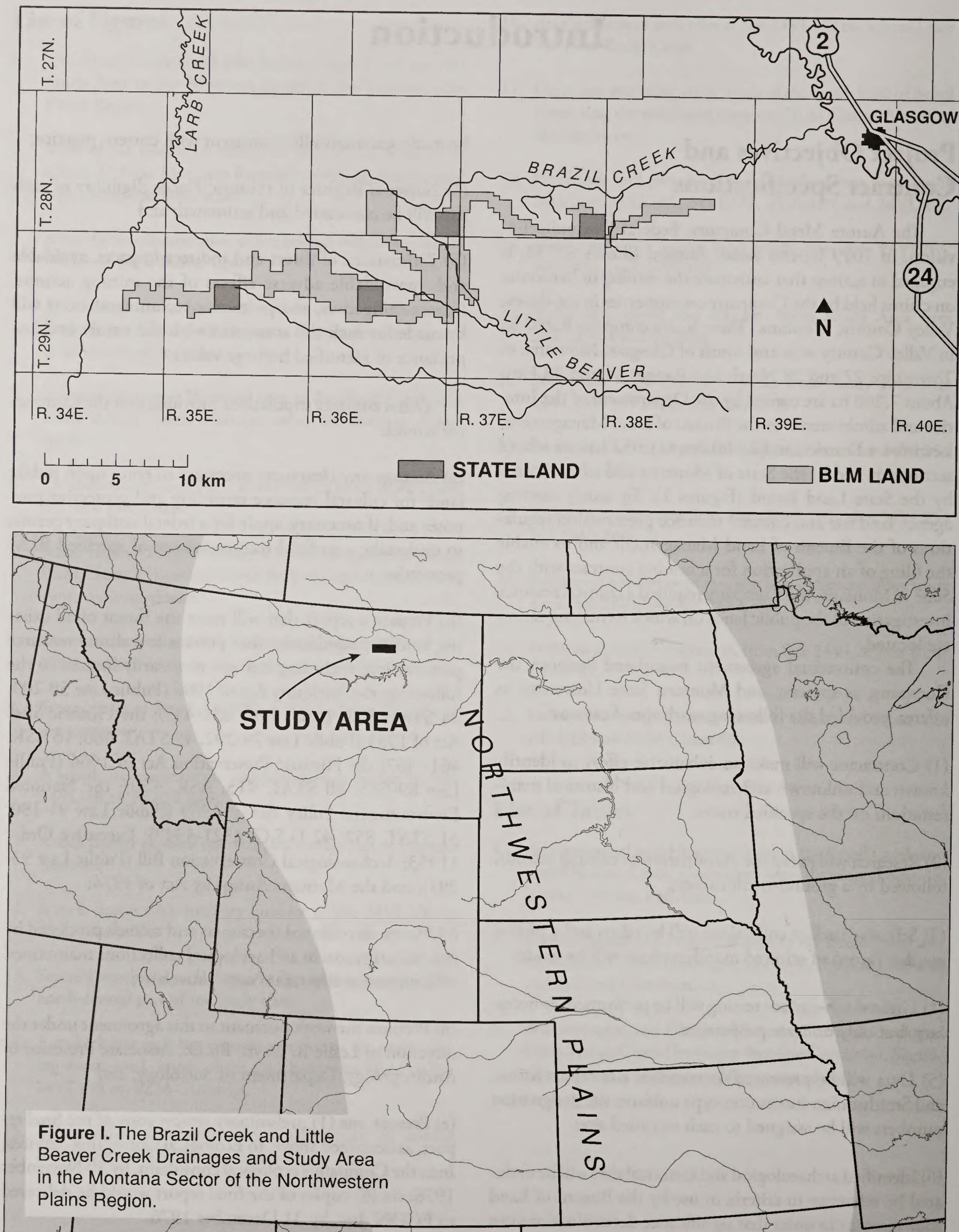



**Figure I.** The Brazil Creek and Little Beaver Creek Drainages and Study Area in the Montana Sector of the Northwestern Plains Region.

## Authorization

The contract under which the Brazil Creek/Little Beaver Creek study proceeded was signed by the Aurora Metal Company representative on 19 July 1976, and by the Montana State University research administration on 26 July 1976. A much earlier contract start had been advised; however, negotiations were concluded late in the field season. The project crew was dispatched from Bozeman to Glasgow, Montana (the base for field operations) on 26 July; fieldwork commenced the following day.

Despite the lack of adequate lead time during which to secure necessary permits, an application for a Federal Antiquities Act exploration permit covering lands administered by the BLM was filed 27 July, following a meeting on the project situation in Lewistown with BLM archaeologist, Patti Bell, on 26 July. Permit 76-MT-106 was issued 29 September 1976 by Rex L. Wilson, Departmental Consulting Archaeologist, National Park Service, Washington, D.C.

A copy of the federal antiquity permit application, which identified the affected state lands, was filed with Dr. Dee C. Taylor, archaeologist on the Governor's Advisory Council For Historic Preservation, at the University of Montana. Taylor reported by telephone, following a search of University records, the absence of records of archaeological sites in the study tract. Nor was he aware of any previous archaeological investigations conducted in any part of the tract. Taylor provided a block of Smithsonian Institution-type site numbers (24VL101 through 24VL425) for assignment to sites identified during the Brazil Creek/Little Beaver Creeks inventory.

## Project Staff

Personnel selected to participate in this cultural resource inventory and assessment project included: Davis, as principal investigator and director (Ph.D. in Archaeology, University of Calgary); Aaberg, as field supervisor (B.A. in Anthropology, University of California-Berkeley), John Darroch (B.A. in History and Research Associate to the Museum of the Rockies, MSU), S. Carol Yonkee (B.A. in Anthropology, MSU), Marc Smith (senior in Anthropology, MSU), and Kristie Arrington (B.S. in Zoology, MSU) as field assistants; and Sue Curtis (M.A. in History, MSU), as historian. William Spencer (senior in Anthropology, MSU) served as laboratory assistant, Valerie Baker as field cook, and Cel Allard (B.A. in Microbiology and senior in Anthropology, MSU) as report typist.

## Problem Orientation

Technical attention was drawn to the study tract by the imminence of industrial development, rather than as a result of the attractiveness of the area for the resolution of a defined archaeological problem. The fact that the study tract occupies a dry "upland" intermediate between two major watercourses, the Milk River to the north and the unique Missouri Breaks riverine ecosystem to the south, was of some anticipatory interest. The principal problem posed by the Brazil Creek/Little Beaver Creeks preliminary surface reconnaissance was of a practical, methodological nature rather than a problem of an academic type. Furthermore, the developed archaeological record for this part of the Northwestern Plains is spotty, superficial, and of minor importance in terms of scientific relevance. The contractual requirement of achieving comprehensive coverage of the mining claims, for the purpose of identifying and protecting heritage manifestations, was therefore the guiding and controlling consideration. It was expected, however, that the investigation could yield some informational benefits. Evidentiary highlights and their problem-related implications, as derived from the inventoried heritage manifestations, are specified to aid future investigations in similar types of Northern Plains ecotones.

Petroglyph Boulder found by John Darroch (1976) during survey on BLM property at Site 24VL224.

# Investigative Design and Constraints

## Literature Search: Prehistoric

Unpublished site records in statewide files maintained at the University of Montana and in research files at Montana State University were checked initially, followed by a perusal of information available in the state historic (archaeological and historical sites) compendium.[1]

Published and unpublished source materials in possession of the principal investigator provided a comprehensive coverage of known archaeological manifestations in the Northwestern Plains. Archival research had demonstrated the lack of prior archaeological endeavor in the immediate study tract.

## Literature Search: Historic

The search of historic records pursued three primary objectives:

(1) determination of the historical background of the general geographic region, with emphasis on those events that may have influenced land-use practices within the study area;

(2) identification of prevailing land-use policies and analysis of developments that occurred since the 1930s under federal management that may have influenced the study area; and

(3) specification of land-use and development histories of three historic occupation sites identified on-tract.

Research objectives were accomplished using appropriate methods:

(1) Historical Background. Standard historical research procedure was employed, namely a search for documents and published literature in the Montana State University, Montana Historical Society, and Valley County libraries for mention of the Milk River region in general and the Brazil Creek/Little Beaver Creeks drainage area in particular.

(2) Federal Land Use Policies and Practices. Both archival research and personal communication were employed in an attempt to ascertain federal land management policies in effect since much of the land in this region had reverted to federal ownership in the 1930s. Pertinent documents, including three area-level assessments for 1940, 1953, and 1960, were located in the respective libraries.

Attempts were made by personal contact with personnel of the BLM and the U. S. Geological Survey to learn the number and kinds of leases issued in the study area between 1934 and 1976. BLM personnel responded by stating that only those grazing leases in effect for the current year were on file; they were uncertain as to the location of previous lease records. The U.S.G.S. provided 10 individual well records for the tract; information concerning the results of drilling was not, however, available to the public.

(3) Specific On-Tract Historic Sites. After the three historic sites were identified by the field survey crews and located by section, township, and range, records in the Valley County courthouse were investigated. Information abstracted from these records included the original homestead patent, ownership history, and leasing (oil, gas, and mineral, but not grazing) history. Long-term land-use records were not available in these records.

## Survey Design Considerations

The more traditional strategies that underlie archaeological surveys involve a priori approaches and decisions that rely heavily on "known archaeological evidence" (Mueller 1974a). Even the more recently developed problem-oriented survey strategies depend, to varying degrees, upon available information or upon the insights of experienced archaeologists. The determination of the reliability of accumulated experience in this part of the Northwestern Plains region to any specific microenvironment is largely a matter of informed judgment. This became particularly evident when the Brazil Creek/Little Beaver Creeks reconnaissance situation was studied. Specific lands in the study tract had received no previous attention. Moreover, within a 48 km radius of the center of the tract, only two reported instances of archaeological activity are known: Taylor's (n.d.) surficial survey of occupation sites along the Fort Peck Reservoir shoreline, and notes on Late period prehistoric bison kills along Milk River near Saco (Davis 1966) and near Hinsdale (Davis 1975). Extension of this radius to 81 km permitted the addition of more data reported from additional surface survey farther west along Milk River and north of Malta into the Whitewater and Frenchman Creek drainages.

Surficial work by Judy Hoy extended varying distances from Malta: Late period bison kills (Hoy 1973) along and near Milk River, an Early period occupation site (Hoy 1969a) in the vicinity, petroglyphs (Hoy 1969b), and a rock cairn (Hoy 1970) along Alkali Creek. A concerted, but extensive survey essentially to the north of Hoy's research locality yielded minimal records of 59 sites, most of them open-air prehistoric habitation sites, but also of several Late period bison kills, prehistoric and protohistoric human inhumations, and prehistoric petroglyph boulders (Davis 1975).

Further extension of the radius to 70 mi (113 km) from study tract center introduced very little additional comparative data, although there are inevitably more if not better records available as progressive distance away from the study tract is achieved. This radius of coverage could, for comparative purposes, be enlarged indefinitely, depending upon study objectives. In the present situation, there was a critical shortage of comparable archaeological data and experience upon which to establish an explicit survey bias. The study area was thus approached with the intention of slighting no major part of the included surface on the basis of lessons drawn from prior experience.

An appraisal of relatable manifestations within a much larger part of the Northwestern Plains, including the southern reaches of the Canadian prairie provinces and central Montana, also presented a very sketchy and technically uneven basis for predicting the archaeological "content" of a specific, commercially defined sector of the Brazil Creek/ Little Beaver Creeks drainage area. Furthermore, the quality of information values that result from a preliminary surface reconnaissance in severely weathered, upland terrain are only selectively indicative rather than definitive of all local archaeological manifestations. Large-scale, intensive, multi-stage studies, such as the BLM is conducting in the Lewistown District, are necessary for the explicit formulation of research designs and survey strategies appropriate to the archaeology and diverse landforms and ecosystems typical of the Northern Plains.

It was evident, during the brief planning operation, that ground control would be a formidable problem. Only 19 percent of the survey tract, at the eastern extremity, was covered by available U. S. Geological Survey topographic mapping, 15' series. An attempt was made, through the BLM, to obtain "blue line" copy coverage of the western portion of Brazil and Little Beaver Creeks; however, those maps were not yet available for public use.

The only other surface maps available for planning prior to fielding were two Company mining claim maps that displayed claim numbers, generalized legal locations, and projected bentonite pit locations; associated topographic, drainage, and access features were not mapped. A request for appropriately scaled black-and-white aerial photography of the mining claim area could not be met by the Company in the available time frame. Inadequate maps contributed to an inaccurate conceptualization of the access and logistics situation. The only base map available at the outset of the survey, was the BLM South Valley Recreational Access Guide Map (scale:.36'= 1 mi). After the crew had been in the field for some time, a copy of a BLM Sage Hen Planning Map (scale: l"= 1 mi) was brought into use. While these maps were too small in scale and lacking in topographic data to be useful for ground-control purposes, they were useful in locating the trails, reservoirs, and major watercourses which are the most reliable landmarks in the more remote parts of the study area. The uncertainty of some finalized site locations, discussed below, is attributable to the limitations of available maps; however, see corrections in Appendices 1 and 2.

## Adopted Survey Methods and Procedures

Field operations were headquartered in Glasgow. The crew traveled to and from the field daily by suburban; two exceptions were caused by a violent late summer rainstorm and by the necessity of camping several nights to facilitate completion of the survey in the allowable time. The initial ground visit was made on 27 July. Fieldwork concluded on 17 August, and the crew returned to Bozeman the next evening. The core 5-person survey crew committed 18, successive, 10-hour workdays (interrupted only by 4.5 days lost to inclement weather); survey crew members varied up to seven. An estimated 950 person-hours or 95 person-days were committed to work in the field (including travel time); an average of two additional hours per day was expended per person in recording data and record control during late evening hours.

Ground survey was performed on foot, augmented by vehicle assistance in moving surveyors to adjacent traverses. One half-section tract (1.6% of the total area) of the relatively flat, grassy upland surface at the extreme western end of the tract was examined by motorized survey.

Survey each day was performed by a basic crew of five, although the number of surveyors increased to seven when Davis and Curtis assisted. Each individual or pair of surveyors was provided a block of field numbers by Aaberg; these numbers were assigned as an initial site control (see Table l). Surveyors were assigned areas to foot traverse each day; whether they worked individually or in pairs depended on the length and width of each surveyed area.

At the start of the survey, each surveyor was responsible for examining the ground surface along a 50-m-wide

transect while he or she walked in a cardinal direction for a distance defined by the boundaries of the respective mining claims. The 50-m parallel or adjacent transect approach was modified early in the reconnaissance program when it became apparent that diligent adherence to that coverage requirement would prevent completion of the survey during the available time frame. A more widely spaced transect convention was adopted which committed each surveyor to command a 160-m wide surface during each foot traverse. That traverse width allowed a five-person crew to cover a .81 km front during a single surface sweep. The direction and distance walked by the surveyors were controlled by the size and spatial orientation of the respective mining claims. Distances walked during each sweep varied from .40 km to 3.22 km.

The precise route followed during each sweep was not predetermined rigidly. Surveyors were encouraged to select the most "site effective" route while maintaining the predetermined directional orientation of each traverse. The width of each sweep differed, in keeping with the peculiarities of the particular eoctone(s) present in its path. When landforms or surfaces with potentially higher densities of heritage evidence occurred in the sweep path, traverse widths were reduced accordingly. The observation paths were not expanded beyond the 161-m maximum, however, even during the survey of low-site-density types of terrain.

Each crew member was responsible for recognizing and locating cultural remains visible within his or her path and transect. When a site was found, the immediate area was surveyed extensively to ascertain the distribution of cultural materials, to enable estimation of the inclusive surface area. Locational, environmental, and cultural observations were recorded on-site, and a sketch map was drawn; this information was transferred later in Glasgow to site report forms (see Appendix B).

Inadequate map coverage posed a problem of ground control uncertainty that was alleviated, to some extent, by the mining claim maps. These maps show all of the mining claims, their field numbers, legal locations, and projected pit locations. In the field, all claim corners had been marked previously by a white 4 x 4-inch vertical post to which is attached a tin plate where the claim number, the claim corner, and the legal description of the claim are printed; unfortunately, some of those claim corners had been changed and the changes were not reflected on the mining claim maps. Also, most of the section corners and quarter corners in the survey tract are identified by a U. S. General Land Office pin. Although the topographic features associated with the sites could not be identified independently on the small-scale base maps during the survey, it was possible to locate each site relative to specific mining claim markers and brass section pins.

Surface collections were made selectively, as warranted by the remains in evidence. Artifacts with historical and functional diagnostic value, such as projectile points, scrapers, knives, pièces esquillées, hammerstones, pottery, and historic objects, were collected. The ubiquitous flakes and spalls of quartzite and quartzite cores and choppers were seldom collected because of their low interpretive value; collections of such materials should, however, be made during mitigation programs as a preservation routine. Samples of lithic debitage, or waste, were taken when exotic lithics were in evidence since some exotic types are fairly sensitive as horizon markers. Only the identifiable bones were taken when utilized faunal remains were found at prehistoric sites. Collections were assigned temporary site numbers and sacked in the field. Artifacts, lithic debitage, and faunal remains were sorted and cleaned in Glasgow and labeled and catalogued later at Montana State University.

Minimally descriptive and selected dimensional observations were taken on most of the identified archaeological features, such as stone circles (tipi rings), rock clusters, rock alignments, drive lines, cairns, hearths, and surface depressions. Identification and location were, after all, the principal field objectives of the reconnaissance program. Photographs were taken selectively to record various of the abundant features and the variegated, stark landscapes of the study area.

## Limiting Factors

Archaeological surveys seldom operate under optimum field and human resource conditions, and the Brazil Creek/ Little Beaver Creeks inventory was no exception. Despite the fact that project personnel were experienced and determined to do a creditable job, we feel that the limiting conditions enumerated here did reduce performance slightly below the level envisioned at the outset. We had intended to achieve an effectively 100-percent surface coverage on all surfaces designated as mining pits, with a total surface examination of a high percentage of those surfaces somewhat more remote from specific anticipated mining locations.

Interference arrived from several sources. The study area proved more rugged, inhospitable, and inaccessible than had been anticipated; the two-wheel drive, 9-passenger suburban was barely adequate to meet physical demands presented by the ground situation. The lack of prior knowledge of local terrain and access restrictions prompted a costly trial-and-error approach in simply getting to the respective mining claims. On-tract vehicle travel

was restricted, for the most part, to one rarely traveled road and a few faint "tracks." Rain squalls and periodic cloudbursts plagued these routes; the suburban was stuck on five occasions. Periods of immobility and time lost because of inclement weather consumed 4.5 precious days; a half day was lost in waiting for a road washed away by a cloudburst to be rebuilt.

The survey area is typified by extremely friable sediments, severely dissected landforms, and deep arroyos. Erosion and deposition can occur very rapidly. These ongoing processes have concealed and scattered many local heritage values. A condition of qualified "preservation" prevails at the western end of the tract; the effects of destructive exposure processes are more typical of the eastern part. To the west, on many of the higher elevation ridges and on gently sloping erosion surfaces, a thick mantle of prairie grasses and sage effectively obscures the surface. Some stone features are virtually hidden beneath recent wind-deposited sediments, colluvium, and vegetation. The integrity of buried artifacts and debitage may have been preserved under these "stable" mantles. Surface-collecting activities and site recognition were also inhibited by the cobble and pebble lag pavements that dominate some local surfaces.

Loss of survey time due to factors mentioned above led to the adoption of the 160-m traverse. It was not possible, therefore, to inspect every square meter of inclusive terrain. The area within the individual foot traverses could range from 6.4 ha to 51.8 ha. As much surface area as could be practically maintained by an observer was examined during each traverse. Particularly close attention was paid to flat surfaces, upland erosional remnants, stream terraces, potable water sources, and arroyo exposures; these situations were present in one combination or another in each survey path. Survey efforts were also intensified in the vicinity of projected pit locations, since these specific locales would be particularly sensitive in view of the projected adverse effects of mining activities.

# The Natural Stage & Antecedent Land-Use Practices

The prehistoric human occupation of northern Montana could have initiated more than 11,500 years ago, although traces of Early Prehistoric utilization of local resources are meager indeed. Whatever its duration, it is known that prehistory ended and history began 170 years ago with the arrival, in 1805, of the Lewis and Clark Expedition on the High Plains via the Missouri River (Coues 1893; Thwaites 1904; Devoto 1953; Jackson 1962; Appleman 1975).

## Local Natural Resources As Land-Use Attraction[2]

The subject Brazil Creek/Little Beaver Creeks drainage system is entrenched in the Prairie Peneplain or Missouri Coteau aspect of the Great Plains physiographic province (Alden 1924). These perennial streams are tributary to the Milk River to the north. The area is underlain by hundreds of meters of late Cretaceous age sedimentary beds composed of alternating formations of shale and sandstone. Each weathers distinctively. These flat-lying, stratified, sedimentary beds, the products of ancient seas and deltaic accumulations, weather into a low-relief topography.

Bearpaw Shale, the dominant sedimentary unit exposed in the study area today, is described as a "thick, monotonous sequence of dark bentonitic sandy and silty shale, which weathers to a characteristic gumbo soil. Bearpaw Shale includes abundant marine fossils and widespread gypsum similar to the composition of the underlying Claggett Formation. Ash produced by volcanic activity, associated with the initial stages of mountain-building in the plains near the end of the Cretaceous, was carried into eastern Montana where it became a component of the Bearpaw bentonitic shales.

Characteristics of the Bearpaw Shale, as a soil, are pertinent to understanding the baseline condition of those heritage manifestations that rest on or are partly contained in this unit:

The Bearpaw Shale unit consists of two types of sediments varying appreciably in bentonite content. The two behave differently upon weathering and are substantially different in engineering characteristics. The non-bentonitic shale weathers deeply to an olive-gray soil The bentonitic shale, because of the swelling clay, does not weather deeply and tends to be sealed by water absorption. Corroded crystals of gypsum form in the weathered zone of both and probably represent thorough leaching of the surface layers. The soil resulting from weathering of the bentonitic shales is impermeable to fluid transmission.

The oldest preglacial surface deposit in the study area is the Flaxville Formation of Miocene-Pliocene age. This formation consists of "predominately...smooth, well rounded pebbles averaging 5 cm in diameter. Most are brownish gray, very fine to medium grained quartzite, with reddish argillite pebbles less common." A coarse, pebble lag results from the weathering of the cemented Flaxville conglomerates.

The continental Illinoian stage of late Pleistocene glaciation overrode the study area, while the latest Wisconsinan glaciation advanced only as far south as the northern margin of the Milk River valley. Glacial outwash and fluviolacustrine deposits add a further subdued appearance to the already low-relief topography. Deposited on the surface of the study area are glacial erratics and boulders, many of which have long since been weathered to low elevations.

A long and persistent series of landforming and landscape-altering processes have brought the study area to its present condition. Weathering processes continue, threatening the preservation of paleontological, prehistoric, and historical values that testify to manifold and ephemeral acts performed on this natural, but ostensibly marginal stage, beginning many millenia ago. Regardless of the climatic and erosional conditions that prevailed at any given point in time, the study area was always an integral part of a vast ecosystem. That its vegetation and water attracted game cannot be doubted, since mammoths, bison, and lesser herbivores grazed here in numbers.

## An Overview of Prehistoric Adaptive Systems in Regional Perspective

The Brazil Creek/Little Beaver Creeks study area occupies but a small surface within the Northwestern Plains archaeological region (Figure 1), a part of the Great Plains archaeological culture area of North America (cf. Strong 1940; Mulloy 1952, 1958; Wedel 1961, 1963, 1964; Caldwell 1968). This central North American grassland is one of the largest of the interior grasslands of the world (Webb 1931; Malin 1956, 1967; Dodge 1959). The Northwestern Plains is an extensive short-grass plains and tallgrass prairie that occupies, for our purposes, the southern halves of Alberta and Saskatchewan, the southwest corner of Manitoba, Montana, and Wyoming east of the Continental

Divide, and the western part of the Dakotas and Nebraska. The western aspect of the Northwestern Plains is referred to here as the High Plains to distinguish the short-grass plains in the west from the tall-grass prairies that occupy much of the eastern part of the northern Great Plains.

The thousands of prehistoric people who frequented the High Plains area of Montana, on either a perennial or seasonally determined resource-using schedule for thousands of years, had much in common. They were specialized big-game hunters who supplemented their primarily high protein, meat-centered nutrition with small game and plants. All of these groups were adapted to the technological possibilities of the Stone Age. All were foot nomad populations that shifted residence from one locality to the next in response to seasonal changes in food resource opportunities and the persistent need for shelter, water, fuel, and stone for tool production.

Some of the variations evident in the regional prehistoric cultural record can be explained as responses to climatic changes that altered the life-support potentials of occupied environments. Some of the evident changes in exploitative practices were thus controlled to some extent by the availability of food resources. Other material culture variations may reflect the interventions of other cultures that entered the region periodically or innovations stimulated by internal cultural factors.

Patterned regularities in the prehistoric record of the Northwestern Plains region have been equated, in general terms, with lifeways (see Appendix A). Those named lifestyles are regarded by archaeologists as distinctive in form, in life span, and in spatial distribution during prehistory. They constitute a sequence of culture complexes and phases that are grouped into relatively long-lived cultural periods (Mulloy 1958; Reeves 1969):

**Early Prehistoric Period**
**(ca. 15,000-13,000 to 5,500 B.C.**

- Clovis Complex (10,000 to 9,000 B.C.)
- Folsom-Midland Complex (9,000 to 8,500 B.C.)
- Agate Basin-Hell Gap Complexes (8,500 to 7,500 B.C.)
- Alberta-Cody Complex (7,500 to 6,500 B.C.)
- Lusk and Frederick Complexes (6,500 to 5,500 B.C.)

**Middle Prehistoric Period**
**(ca. 5,500 B.C. to A.D. 200)**

- Mummy Cave Complex (5,500 to 3,500 B.C.)
- Oxbow Complex (3,500 to 2,500 B.C.)
- McKean Complex (2,500 to 1,500 B.C.)
- Duncan-Hanna Phase (1,500 to 1,000 B.C. )
- Pelican Lake Phase (1,000 B.C. to A.D. 200)

**Late Prehistoric Period (ca. A.D. 200 to A.D. 1,800)**

- Avonlea Phase (A.D. 200 to A.D. 700)
- Besant Phase (A.D. 200 to A.D. 750)
- Old Women's Phase (A.D. 200 to A.D. 1,800)

Hunters of the initial Early Prehistoric period (Mulloy 1958) emphasized mammoth (*Mammuthus* spp.) as their focal prey (Wormington 1957; Haynes 1966). These early hunting cultures were active during early postglacial times (13,000 to 11,000 years ago), during the Anathermal climatic interval (Antevs 1955; Mulloy 1958). The Northern Plains was, at that time, a lush grassland, laced generously with extensive bodies of glacial meltwater. The climate was generally cool and moist, with intermittently heavy rains. Small bands of hunter-gatherers lived close to mammoth herds during these times of relative abundance.

By 11,000 years ago, much of the lush vegetation and standing bodies of water had vanished, and the grasslands began to resemble the modern type and condition. Intense selection pressures were experienced by mammoth and associated populations of megafauna due, in part, to the climatic changes that reduced their food supply to a precarious level. Giant bison became the principal prey of hunters, augmented by the occasional camel, horse, and antelope, due to the unreliable availability of mammoth and the larger numbers and wider distribution of bison.

Climatic change continued, with selective consequences. The progressive restriction of grazing range caused a pronounced decrease in game herd size and distribution. Disease and predation pressures further reduced herd sizes and the numbers of associated biota well below the number required for reproduction and population maintenance. By 10,000 years ago, more than 30 late Pleistocene genera in the New World had failed to survive these pressures and had become extinct (Martin and Wright 1967).

The giant bison (*Bison* spp.) evolved into a smaller form, the modern species, *B. bison bison*, during this difficult geoclimatic interval (cf. Wilson 1969). Plains hunters adapted readily to the pursuit of these numerous, widely distributed, gregarious animals.

By 7,000 years ago, available grazing range had diminished even farther as the grasslands desiccated to a critical level during the Altithermal climatic interval (7,000 to 3,000 years ago). Some expanses of the arid-variable Great Plains margins may have been abandoned by big game and man, in company with other herbivore-dependent predators. Scholars continue to disagree about the nature and extent of the impact that the Altithermal drought exerted upon the distribution of wildlife and human populations; Hurt (1966) and Reeves (1973) represent differing positions and opinions, for which Reeves makes the more

compelling case.

The Middle Prehistoric period thus witnessed a shift away from an idealized single-minded reliance on big game. In some localities, an apparent reduction in the nearly exclusive use of big game may have been accompanied by an offsetting increase in the utilization of wild plants and small game.

By 3,000 years ago, bison hunting on a periodic, communal scale was resumed as a consequence of improving climate and the expansion of the depleted bison population. The onset of Medithermal climate at this time correlates with the initiation of Pelican Lake phase activity in the late Middle period. The climate of the northern Great Plains apparently stabilized at about this time; the climate in the region today is comparable to that of 3,000 years ago. The Medithermal has been punctuated at intervals, however, by episodes of periodic cooling that produce alpine glaciers in cirque basins in the Rocky Mountains, and by cyclical droughts of more or less extended durations.

The Middle Prehistoric period ended and the Late Prehistoric period was initiated ca. A.D. 200 with the introduction of the bow and arrow into the Northern Plains by newly arrived hunters of the Avonlea phase. Communal bison hunting occurred thereafter on an unprecedented scale as a result of the continued rapid rebound of bison populations and the application of a more efficient hunting technology. The number of more or less perennially resident hunters also increased notably, and the rate of intercultural contact and exchange of goods intensified during the Late period.

A.D. 1,700 to 1,750 brackets roughly the Protohistoric transitional interval between prehistory and history (Wormington and Forbis 1965) .The introduction of the horse ca. A.D. 1,730-1,740 into the Northwestern Plains, followed thereafter by the arrival and adoption of trade guns, knives, other metal trade objects, and trade beads among the occupying Native Americans populations prior to the appearance of European traders, signifies the merging of Stone Age prehistory with the manufactured goods of the Industrial Age. Rapid and widespread cultural changes occurred during succeeding decades (Wissler 1914; Haines 1938; Roe 1955; Ewers 1931). The well-known, flamboyant horse cultures of the western part of the Northern Plains developed to their climax stage rapidly. The adaptability and genius of these now pedestrian, nomadic hunters are legendary.

## Native American Land Users

Early Amerindian residents of the Northern Plains represented numerous distinctive cultures. Many of these cultures are well known as a consequence of field studies performed by anthropologists and others just after the turn of the century and subsequently (Curtis 1907-30; Hodge 1912; Swanton 1952; Kurz 1937; Denig 1930; Hayden 1863; Lowie 1954). Identifiable ethnographic populations and bands of Blackfeet, Gros Ventre, Assiniboine, Dakota, Kutenai, Crow, Cree, and Shoshone probably frequented the area over time (Wissler 1910; 1911; Schultz 1907; Ewers 1958; Grinnell 1961; Kroeber l900; Rodnick 1938; Flannery 1953; Lowie l909a; Dusenberry 1960; Denig 1961; Turney-High 1941; Lowie 1922, 1935; Mandelbaum 1940; Dusenberry 1962; Steward 1938; Hultkrantz 1968; Malouf 1968; Lowie l909ba).

With the exception of the Plains Kutenai and traveling bands of Shoshoni, the aforementioned tribes probably did not enter northern Montana until after A.D. 1,600 (Malouf 1956, 1967; Taylor n.d.). However, two of the three federal Indian reservations located today in Montana north of the Missouri River reflect the fact that certain of these groups were the historical antecedents of resident populations of hunter-gatherers located there in former times: the Fort Belknap Reservation (Gros Ventre and Assiniboine) and the Fort Peck Reservation (Sioux and Assiniboine). The Cree and Chippewa residents of Rocky Boy's Reservation, located in the Bearpaw Mountains west of the heritage study area, are also latecomers to the northern Montana plains. Their land claim lacks the same traditional territorial use basis that legitimized the claims of the Assiniboine, Gros Ventre, Dakota, and the Blackfeet. The Piegan group of Blackfeet, residents of the Blackfeet Reservation to the west in northern Montana today, also played an active role in the area during early history, as did the Crow somewhat later. The area was an open territory that was frequented through time by native hunters who were compelled eventually to enter into intense competition for bison hunted seasonally by many groups and year round by some.

## Historical Land Use: Early to Present Day

The Brazil Creek/Little Beaver Creeks study area stands apart from the mainstream of Montana's early history. Most early historic human activity in the state was concentrated along the broad river valleys that afforded easy transportation routes, abundant game, and fertile soil. In contrast, the uplands between the Milk and Missouri Rivers (of which the study area is a part) constitute an arid region that becomes nearly impassable when annual rains turn the poor soil into mires of sticky gumbo mud.[3] The diaries, journals, and reports that document non-Indian activities in early-day Montana are largely silent about this area, with

only the occasional mention that it was home to Indians and wild game.

The earliest non-Indian to record their passage through the general area were Meriwether Lewis and William Clark, who stopped briefly at the mouth of the Milk River on 8 May 1805. Clark explored the banks of the Milk River for about 3 mi before the Expedition continued west up the Missouri (DeVoto 1953:106-107). On their return journey a year later, Lewis' party passed the mouth of the Milk River on 4 August, but they did not investigate that area further (DeVoto 1953:442).

Although subsequent decades witnessed an influx of trappers into Montana along the Missouri River, the first comprehensive observations of the Missouri-Milk Rivers region were made in the 1850s. In 1854-1855, Isaac S. Stevens, sponsored by the U. S. Government, led an expedition across the Northern Plains to the Pacific Coast to ascertain the best route for a transcontinental railroad. Forewarned by trappers of the rugged country and hostile Indians who awaited them up the Missouri, Stevens chose to explore a more northerly route that followed the valley of the Milk River. Small parties of men were periodically detached from the main expedition to explore the country on either side of the Milk River, but Stevens (1901:89, 91) did not record where the groups went. He (Stevens 1901:91, 236) did note, however, that

*...game (was) very abundant, plenty of buffalo... an exceedingly fine grazing country...the buffalo is found here in very large numbers...*

Stevens also reported an encounter in this region with 300 lodges "of the Gros Ventres tribe of the Blackfoot nation," and he observed that the area served as both their winter and summer home. In 1855, Stevens made a treaty with the Blackfeet, and the Brazil Creek/Little Beaver Creeks locality was included in the lands reserved for that tribe (Stevens 1901:110-117) .

By 1860, steamboats had successfully navigated the Missouri as far west as Fort Benton; in 1862, gold was discovered in southwestern Montana and this river became the major artery into the gold fields. Some emigrants, however, chose the slower and less expensive route overland. Between 1862 and 1867, several wagon trains--known collectively as the Fisk and Holmes Expeditions--followed Stevens' route up the Milk River (White 1966:1, 9, 189-190). As in the past, it was the river bottom that attracted the white men; the adjacent uplands were ignored, except insofar as they provided the emigrants with ample supplies of buffalo and antelope meat (White 1966:62, 128, 189).

The 1870s and 1880s witnessed the elimination of both buffalo and Indians from the region between the Milk and Missouri Rivers. In the late 1860s, emigrants in the vicinity of the Milk River wrote of buffalo herds so large that it took six days to pass them (White 1966: 189). Even in 1876, observers could still comment that, "a good many buffalo" were grazing along the banks of the Missouri (Baldwin 1876). But the invention, in 1871, of a process whereby buffalo hide could be tanned into usable leather created an enormous demand for this commodity; scores of trappers and hunters did their best to fulfill the demand. By 1883, the buffalo had been practically exterminated from the plains, a survey made that year found only 200 (Malone and Roeder 1976:115).

As more and more non-Indian settlers emigrated to the Montana Territory, clashes between the Indians and whites were inevitable. The whites pressured the U. S. Government into pursuing a policy of forced containment of the Indians on reservations; as the number of settlers grew, so did their desire to use the land claimed by the Indians. During the 1870s, the boundaries of the Blackfeet, Assiniboine, and Gros Ventre reservation, guaranteed by the Treaty of 1855, were gradually diminished with a minimum of hostile reaction (Malone and Roeder 1976:91). The neighboring Sioux tribes, however, were less willing to forsake their traditional hunting grounds. During the latter half of the 1870s, the Sioux engaged the U. S. Army in a running battle; recorded incidents occurred outside of the study area. The nearest event was a reconnaissance mission led by Leo Frank Baldwin in 1876 along the north bank of the Missouri through the drainages of Willow and Fourchette Creeks (Baldwin 1876).

The subjugation of the Plains Indians was completed by 1880, and the contraction of their reservations continued. By 1888, the Blackfeet had been confined to the Browning Reservation, the Gros Ventre and Assiniboine to Fort Belknap north of the study area along the Milk River, and the Sioux and other Assiniboines to Fort Peck southeast of the study area (Malone and Roeder 1976:108). Their once-allotted lands between the Missouri and the Milk Rivers were thus "freed" for more "beneficial" use by white settlers.

The tiny agricultural sector that had established itself in western Montana to support the early gold boom towns had burgeoned by the mid-1870s. As more and more people settled in the western valleys, and as the Plains Indians were subdued, stockmen began to move into the eastern plains in search of supplemental rangeland. By the mid-1880s, the range south of the Missouri River was occupied by large cattle outfits such as the N-, the Judith Cattle Company, and the DHS (Fletcher 1960:49). Serious overgrazing and disastrous weather created the need for even

more rangeland; the latter half of the 1880s witnessed the movement of livestock onto the last section of open range in the Northern Plains: northeastern Montana (Fletcher 1960:113). Since by this time the traditional Indian inhabitants of the uplands between the Milk and Missouri Rivers had been confined to small reservation islands, the region was "free" land, and many companies grazed their cattle there. Sheep were also present; by this date, many outfits found it to their advantage to combine both varieties of livestock in one ranching operation (Malone and Roeder 1976:118-119).

Few "home ranches" were located between the Missouri and the Milk Rivers. Most of the livestock that grazed on this range were owned by outfits headquartered elsewhere, such as the DHS and N- on Flatwillow Creek in the Musselshell, and the Hash Knife and XIT of southeastern Montana (Kennedy 1960:137). Two operations (Slaughter & Kyle and Gibson & Carpenter) were headquartered on Larb Creek to the west of the study area (Paladin 1962 5), but no records were found that any such operation was centered on the study area drainages.

The decade of the 1890s saw the decline of the open range. Ranchers began to realize the risks involved in depending on free grass; the native vegetation could not withstand the constant grazing of domestic livestock and the quality of the grasslands gradually diminished. The peculiar climatic conditions of the region required different agricultural methods. Severe winters convinced ranchers of the need for winter feeding; as a result, irrigation, fencing, and other new techniques were introduced (Burlingame and Toole 1957:326).

By the beginning of the 20th century, three factors had combined to bring an end to the open range (Malone and Roeder 1976:181). The first was the apparent success of the new dryland farming techniques. Although the technology was used initially by ranchers to provide supplemental feed for their livestock, experimenters successfully applied the dryland farming technology to the production of wheat and other small grains. It appeared that a way had been found to make the arid plains truly productive. The Homestead Acts of 1909 and 1912 enabled farmers to homestead large tracts of the free land in northeastern Montana. Railroads and land speculators advertised the new agricultural techniques and the availability of cheap land to promote an influx of new settlers to the region.

The years from 1910 to 1918 witnessed an enormous jump in homestead claims; during those years, the homestead applications at the Glasgow Land Office numbered in the thousands.[4] Stockmen were pushed from the relatively rolling uplands into the rough breaks areas, and much of the former rangeland was plowed under.[5]

Because the weather was good and farm products were in high demand, homesteaders had some good years. In 1917, however, a prolonged drought combined with a post-World War I decline in farm prices to knock the bottom out of the Northern Plains agricultural boom. By 1925, more than 20,000 mortgages had been foreclosed, and half of Montana's farmers had lost their land (Malone and Roeder 1976:218).

Following a brief respite during the mid-1920s, the devastating cycle of drought and the Depression continued into the 1930s. Many homesteads were abandoned; there were 435 unoccupied farms in Valley County alone in 1930. Between 1930 and 1935, the population of the county declined by 22 percent; from 1930 to 1940, the number of farm families declined from 1,833 to 1,560.[6]

The economic dislocations of the 1930s resulted in a departure from previous land-use patterns in the Milk River area. Previously, although much of the land was public domain, it had been used by individuals as they saw fit--to farm, to graze their livestock, or to purchase. The Depression years forced the realization that the climate and geography of this region were incompatible with that pattern of land use. The vast plains could not be divided up and used indiscriminately; they had to be considered and managed as a unit to maintain any level of productivity and profitability. Private individuals were unable to control enough land to make comprehensive management possible; that responsibility was assumed by the federal government.

Two programs in particular were important in the Milk River Region. The creation of grazing districts and the outright purchase of private land by the federal government were recognitions of the need for comprehensive land use planning and management.

In 1933, the Montana Legislature authorized the creation of cooperative grazing associations. These associations included all landowners and users (public and private) within a district; associations were empowered to lease grazing privileges and to protect the land from overgrazing and improper use.[7] The Milk River region was divided into four grazing districts; the study area was a part of the Badlands District, which included all of the range land in Valley County south of the Milk River.

This system worked fairly well for a few years, but local politics and favoritism caused a deterioration of comprehensive management activities, and detailed record-keeping languished.

*Administration of state grazing districts does not provide the control needed to carry out a program of improvement and maintenance for Federally owned lands. Definite enforced management of the districts with provisions for limitation on*

*numbers of stock, season of use and other controls are needed... Adequate records of actual use should be kept...basic information needed for systematic allocation and management of public grazing lands is not available.*[8]

In 1934, the Milk River Submarginal Land Purchase Program was instituted in Valley County. This program was designed to remove land unsuitable for farming from private ownership and return it to the public domain, where it could be managed in large blocks for more appropriate uses.[9] These lands were administered first by the Soil Conservation Service, and later by the Forest Service; in 1958, control was transferred to the BLM.[10]

Of the 1,006,420 acres in the Badlands District, more than 90,000 acres were purchased by the federal government under the Submarginal Land Purchase Program; 95 percent of the district was publicly owned.[11]

In 1940, only 21,189 acres of the Badlands District were in crop.[12] The rest of the acreage was under use "for range purposes."[13] The District has continued to be managed primarily as a grassland range resource since that time. Division of administrative responsibilities between federal agencies and the grazing association made it difficult to ascertain data specific to the study area; some of the general management practices applied in the district and county were undoubtedly also applied in the study area.

Assessments of the quality of the rangeland south of the Milk River have changed over time to some degree. In 1940, three-fourths of the land was considered "fourth and fifth grade grazing, or of a grade which requires 38 or more acres to produce enough grass to graze a steer for 10 months."[14] Thirteen years later, the southern portion of Valley County was classed as "inferior" grazing land.[15] In 1960, however, the rangeland in the study area was assessed as good to fair in condition. Range deterioration was attributed primarily to poor distribution of water supply (which concentrated livestock grazing near the water) rather than to overgrazing, per se.[16]

Both sheep and cattle have been grazed on the rangeland. In 1935, it was estimated that 16,164 head were grazing the Badlands District; in 1938, 6,264; and in 1940, 8,420 (more than two-thirds were sheep).[17] Statistics for the county as a whole indicate that the number of cattle has increased, while the number of sheep has declined substantially.[18]

Historically, the dominant land use in the study area has been grazing; mineral development efforts appear to have been undertaken only sporadically. Government documents indicate that three wells were drilled in the tract between 1922 and 1960; whether the lessees were searching for oil, gas, or water is not specified. All three wells were "dry."[19] Court records show that Delhi Oil Corporation leased various sections within the study area during the 1950s, but information concerning developments on these leases is not available .[20]

As recently as 1960, federal management plans for the general area relegated mineral exploration to a decidedly low priority:

*Minerals do not loom large in the future of the area. Gas and oil production is decreasing rapidly. All recent exploration has resulted in dry holes..of these leases will probably be dropped unless new discoveries are made in or near the area soon... Future demand may cause development of clays, bentonite... Sub-bituminous coal reserves in the area are huge, and may be of future value for thermal electric power or chemurgy.* [21]

The rate of exploration and development increased noticeably during the 1960s and 1970s. Oil and gas leases have been issued for large sections of the tract, but court records do not describe specific developments, if any, that resulted.[22] Government records do indicate that at least seven oil or gas wells (all "dry") were drilled between 1967 and 1975 by various companies.[23]

The U. S. Soil and Conservation Service has been providing technical assistance and building dams as stock-watering reservoirs in northern Montana since 1938; since records are destroyed routinely every five years, it was not possible to determine when the stock ponds in the study area were developed.[24]

Considerable activity has occurred in connection with the development of bentonite. Court records note that core-drilling, road-building, and surveying valued at $11, 300 was conducted on 99 claims in the tract in 1962 by the Brazil Creek Bentonite Company (Robert W. Hansen, Mary Hansen, Jean Hansen, Robert Hurly, F. J. Merson, Jr., Leslie L. Hanson, A. W. Crawford, and Hazel Crawford).[25]

Information provided by the Federal Bentonite Division indicates that the Company acquired the lease from the Brazil Creek Company and drilled approximately 90 test holes in 1965. Nine experimental pits were mined in 1966 and 1967 by local contractors. Extensive drilling for assessment and proving out tonnages occurred during a 39-month period between January 1966 and August 1976.[26]

Other developments associated with the bentonite mining include: the construction of a road to the plant site and 15 mi west beyond it in 1967, 1968, and 1969; soil-sampling at the plant site in 1967; installation of a telephone line in 1968; and the construction of a railroad spur to the plant site in 1969 and 1970.[27]

# Reserved Natural and Cultural Heritage Values[28]

The physical manifestations in the Brazil Creek/Little Beaver Creek mining claim area, which are reserved and accorded protection under aforementioned laws, in the public interest, include:

(1) Paleontological fossils, as a natural resource, to which are attributed scientific and educational values; and

(2) Artifacts and other residues of human activity (with the temporal and technical division of "'prehistory" and "'history") which constitute cultural or heritage resources to which are attributed scientific, educational, and recreational values.

## Paleontological Manifestations

Certain of the sedimentary formations exposed and weathered in the study tract reveal varieties of late Cretaceous dinosaurs and unidentified continental vertebrates and marine invertebrate fossils. The vertebrates tend to be exposed in a limited number of localized pockets, while the marine fossils are ubiquitous and more abundant.

An oyster, *Ostrea patina*, is common as a stratigraphic marker in certain of the Bearpaw shales. Large septarian concretions and nonseptarian fossiliferous limestone concretions are also present in the Bearpaw shales of the Montana Group. The overlying Hell Creek Formation, which represents a continuation of continental sedimentation, is characterized partly by the presence of the bones of vertebrates and fossilized wood.

Specific fossil find occurrences were not documented during the survey. A few of the badly eroded and fragmentary fossils were collected as fossil type examples to preserve the samples for possible comparative use. No exposures of articulated vertebrate remains were found, although two instances of recently disarticulated dinosaur vertebral columns were collected. Fossil ammonites and ammonite septa are fairly common; they tend to appear in weathered concentrations. Freeze/thaw phenomena wreak havoc with the integrity of fossils in this environment.

Ammonite septa were sought by prehistoric peoples and some Amerindians because of their physical resemblance to the bison. They were worn as charms or added to medicine bundles as effigy figures employed in hunt magic rituals intended to ensure the continued fecundity of bison herds. The Blackfeet referred to ammonite septa as *iniskim* or buffalo stones. The study area would have offered a source of supply for these important fossils, but they could have been available over a large part of the Northern Plains.

Whether any of the invertebrate or vertebrate fossils or fossil types present in the study area warrant protective intervention will depend upon the counsel of paleontologists and the position taken on that issue by the BLM. Since paleontological fossils on national resource lands are covered under the provisions of the Antiquities Act of 1906, federal agencies are responsible for giving due consideration to their scientific values and protection.[29] The Montana Antiquity Act of 1974 provides comparable coverage for unusual paleontological fossils in context on registered state properties.

## Sites of Prehistoric Activity

The study tract contains widespread physical traces of prehistoric occupation and resource use, predominantly in the form of utilized quartzite cobbles and wasted quartzite spalls and flakes (Figure 2). Also, small stacks or piles of stones and isolated concentrations of fire-broken rocks (hearths) are common (Figure 3). Many of these obvious occupational residues were not designated as discrete sites since they are so abundant, lack associated remains, and characteristically possess low informational values. These small-scale, low-value residues were checked for probable relationships to other materials in their immediate area before they were excluded as potential sites (see Appendix A for working definitions).

### Site Density

Table 1 lists the identified heritage sites per mining claim; the individual mining claim is regarded, for purposes associated with potential impact analysis, as a management unit. From one to 13 prehistoric sites occur on each of 102 of the 114 mining claims, with an average of 2.9 sites per affected tract (Figure 4). A total of 298 prehistoric sites were recorded (see Appendix B) in the study area[30], with an average of one site per 1/27.7 ha; the 264 sites on federal land average one per 1/27.3 ha, and the 34 sites on state land average one per l/3,009 ha (Figure 5).

### Site Area and Elevation

The 298 sites occupy surface areas that range from "small" to 121.5 ha. Forty-two percent (n=124 sites) occupy

**Figure 2.** View of the weathered surface of Site 24VL254 on BLM Claim 37 near Moccasin Reservoir, showing quantities of bison bone and lithic waste.

**Figure 3.** A weathered concentration of fire-broken rock along a north terrace of Little Beaver Creek.

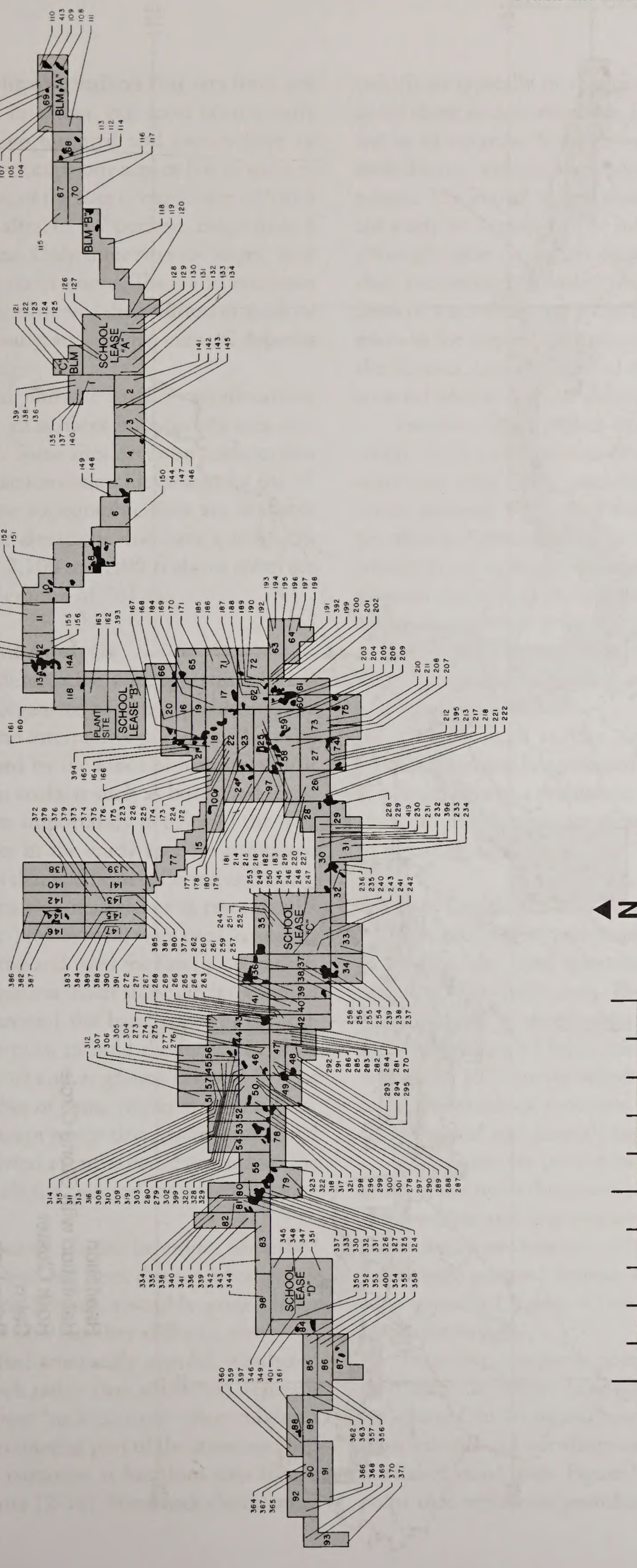



**Figure 4.** Archaeological and historical sites in the Brazil Creek and Little Beaver Creek drainage areas: site distribution relative to proposed pit locations.

**NOTE: Abbreviated Site Numbers**
Example: 24VL101 numbered as 101

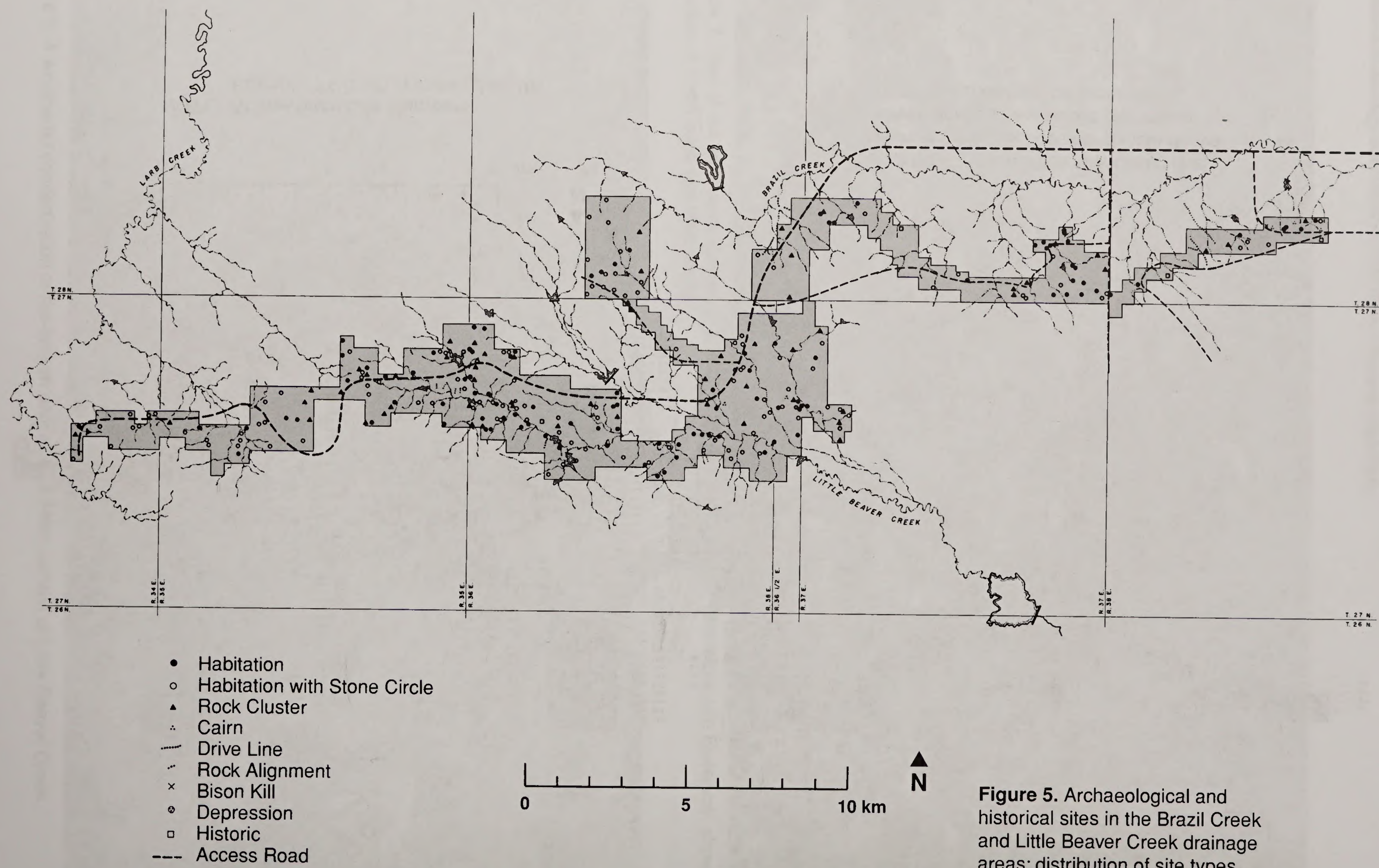



**Figure 5.** Archaeological and historical sites in the Brazil Creek and Little Beaver Creek drainage areas: distribution of site types.

"small" areas; these sites involve surfaces that vary from one square yard to .25 acre in extent, but most occupy only tens of square yards. Two hundred and twenty-four, or 75.2 percent, of the sites occupy one acre or less of surface. Fifty-six, or 18.8 percent, of the sites occupy from l.25 to 5 acres, while another 20 sites, or 6.7 percent, range from 6 to 40 acres in surface area. Only three sites are larger; they range from 80 to 300 acres in extent. These area estimates are based solely upon the observed distribution of surficial physical evidence; obviously, still-hidden cultural deposits may distribute differently.

Prehistoric sites and non-site surface manifestations are present on virtually all surfaces in the study area that are relatively horizontal. Some sites occur on surfaces that possess varying slope characteristics. Elevations for the 58 sites for which adequate topographic data are available reveal that sites occur at elevations that have a relief differential of 97 m, from 2,100 to 2,390 ft above mean sea level, with an average elevation of 701 m.

## Feature Incidence and Analysis

Table 2 displays descriptive and use (functional) characteristics that are organized to define prehistoric site "types" for assessment and interpretive purposes. These site types are thus determined by the kinds of features and/or artifacts present at each; ecofacts such as butchered bison and antelope bone figure importantly in a few of the type determinations. Features in the study area are composed of locally available rocks that had been collected and transported for use as construction material or as raw material for tool production. Fire-broken rocks were used in hearths and fireplaces constructed and used for food preparation; hearths occur rarely as features inside stone circles. Cobbles that had been placed around the basal edges of conical, skin-covered lodges, or tipis, to hold the lodges in place occur as singles (Figure 6) and as groups (Figures 7-9) of stone circles. The number of stone circles at each habitation site was counted, except where circumstances of burial and/or disturbance rendered a feature count unreliable. The most extensive stone circle site counted contained 75 stone circles.

The Brazil/Little Beaver Creeks inventory identified a recurring feature that had not been distinguished previously. These problematic features resemble stone circles in general form (Figure 10), but they differ in several respects. The stones selected are usually angular, weathered fragments of granitic rock rather than smoothed, resistant cobbles (Figure 11). These "rock clusters" often employ a large glacial erratic as an integral part of the structure; this auxilliary rock is most common at locations that have a single rock cluster (Figures 12-14). Some rock cluster series (which are typically smaller in diameter than stone circles) occur along middle-elevation, intermittent watercourses in the lee of uplands. Artifacts are seldom present in or near rock clusters, although quartzite debris was sometimes apparent. The overall spatial distribution of rock clusters in the study area appears to be similar to that of stone circles, although these distinctive features tend to be exclusive in their occurrence. Whether rock clusters served as habitations in ways similar to stone circles is not known. Differences in the selection of construction materials, the size of the features, and their spatial distribution suggest possible seasonal and/or cultural differences.

Features designated as stone piles and cairns, which singly or in combination with other kinds of features constitute sites, differ essentially only in overall size; no burial mounds were observed. Cairns occur typically as prominent, isolated single features (Figure 15). Stone piles usually occur as single, unrelatable features positioned on elevated surfaces, in linear series as segments of rock alignments of uncertain purpose (Figure 16), or in succession as one or more lines of rock that were associated, such as drive lines, with the driving and selective en mass killing of bison (Figure 17).

One artificial surface depression, recorded at site 24VL394, cannot be attributed reliably to historical activity. It is listed here as a prehistoric site because similar depressions of unknown use are present at other prehistoric sites in the study area.

## Artifact Incidence and Analysis

Remarkably few prehistoric artifacts, other than those that reflect the local quartzite reduction industry, were found in the study area. The conclusion that artifacts were collected by sheepherders is inescapable. Thus, since the small sample of lithic and ceramic remains recovered during the 1976 survey reflects selection by collectors and fortuitous erosional processes, it has limited usefulness for chronological and generalizing purposes.

Table 2 lists the per site incidence of certain distinctive artifacts and notes the presence/absence of others. Seventy-five complete and fragmentary flaked artifacts (excluding a few unifacial and bifacial cobble choppers) were collected: 5 projectile points; 9 knives; 16 end and side scrapers; 26 edge-retouched flakes; 9 cores; and 10 pièces esquillées (probable wedges).

Three stone projectile points are illustrated: Figure 18a, represents the Pelican Lake phase, while Figure 18b and c are typical Old Women's phase points, these points are the most reliable culture-diagnostic artifacts present among the flaked stone tools. Figure 18d is a manufactured metal point that represents protohistoric or early historic trad-

**Figure 6.** An undisturbed stone circle at Site 24VL238 on BLM Claim 34, view to the east.

**Figure 7.** Stone circles (24VL395) near a bentonite prospect pit on BLM Claim 27 near the North Fork of Little Beaver Creek, view to the northwest.

**Figure 8.** Stone circles at Site 24VL395 on BLM Claim 27 near the North Fork of Little Beaver Creek, view to the north.

**Figure 9.** Stone circles at Site 24VL395 on BLM Claim 27, view to the southeast.

Figure 10. A small, lichen-covered, embedded rock cluster at Site 24VLI39 on BLM Claim I.

Figure 11. A rock cluster exposed on a deflated surface east of Hamm's Reservoir.

**Figure 12.** A rock cluster with auxiliary boulder at Site 24VL326 on BLM Claim 79.

**Figure 13.** Severely weathered rock cluster with auxiliary boulder in the north-central part of the study tract.

**Figure 14.** A rock cluster near lag deposits just east of the main mining access road, north of the Old Bentonite Plant at Site 24VL158 on BLM Claim 12.

**Figure 15.** A large cairn in the north-central uplands in the mining claim tract, view to the northeast.

**Figure 16.** An alignment of rock piles at Site 24VL132 on School Lease "A" near Brazil Creek.

**Figure 17.** Drive line and stone circle south of the South Fork of Brazil Creek near the northwest corner of BLM Claim 18, view to the northwest.

ing activity. Miscellaneous flaked stone tools include three knives (Figure 19a-e), four end scrapers (Figure 20a-d), three edge-retouched flakes (Figure 21a-c), and three unifacial cobble choppers (Figure 22a-c). Distinctively bifacial, wedge-shaped pièces esquillées were found at sites 24VL254 and 24VL266 (Figure 23a-h); these implements appear to be yet another useful Late period cultural marker.

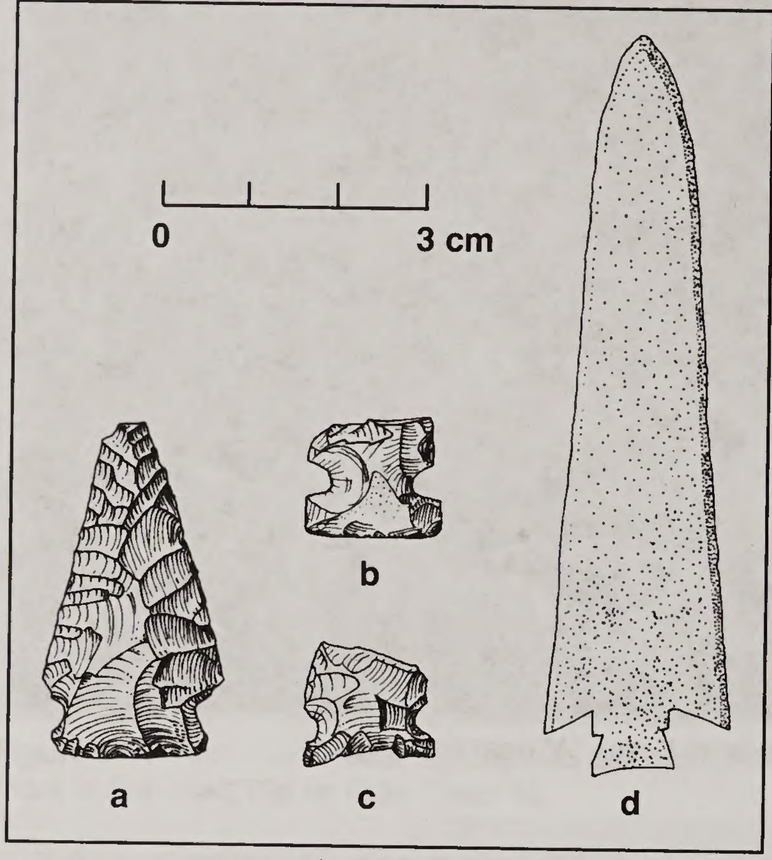



Figure 18. Prehistoric and protohistoric projectile points from Study Area sites 24VL135, 24VL171, 24VL419, and 24VL369.

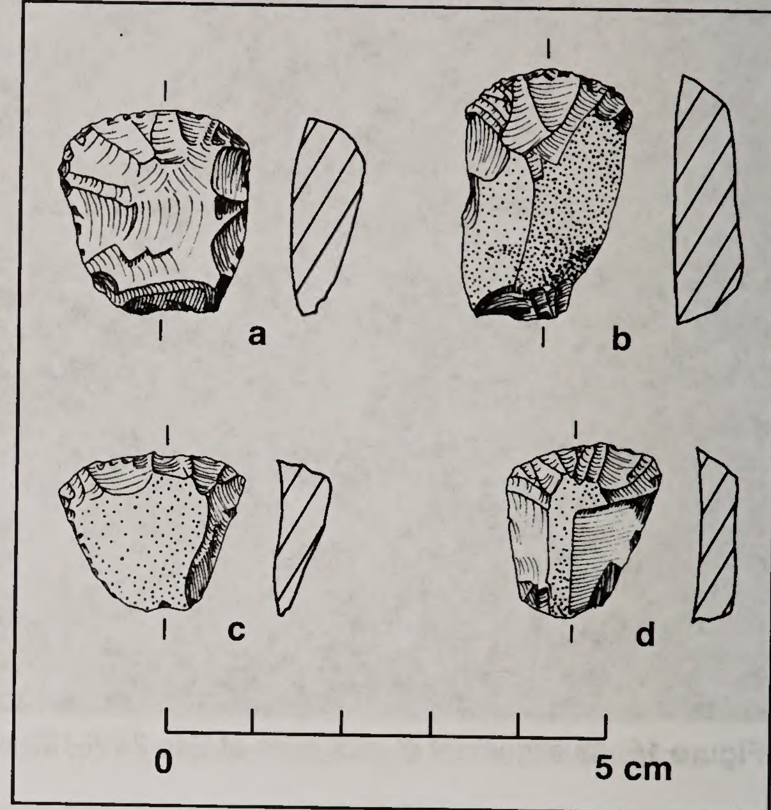



Figure 20. Prehistoric stone end scrapers from Study Area sites 24VL254 and 24VL266.

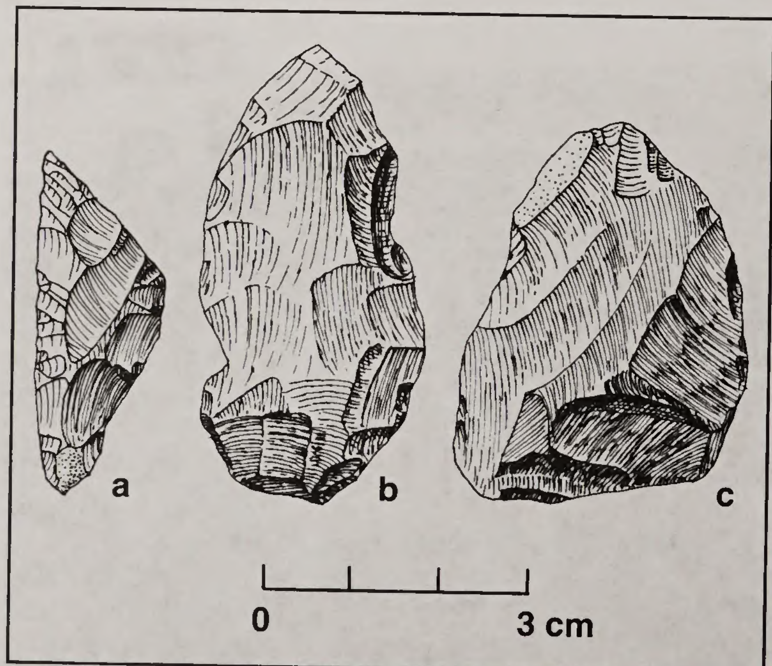



Figure 19. Prehistoric stone knives from Study Area sites 24VL266, 24VL121, and 24VL352.

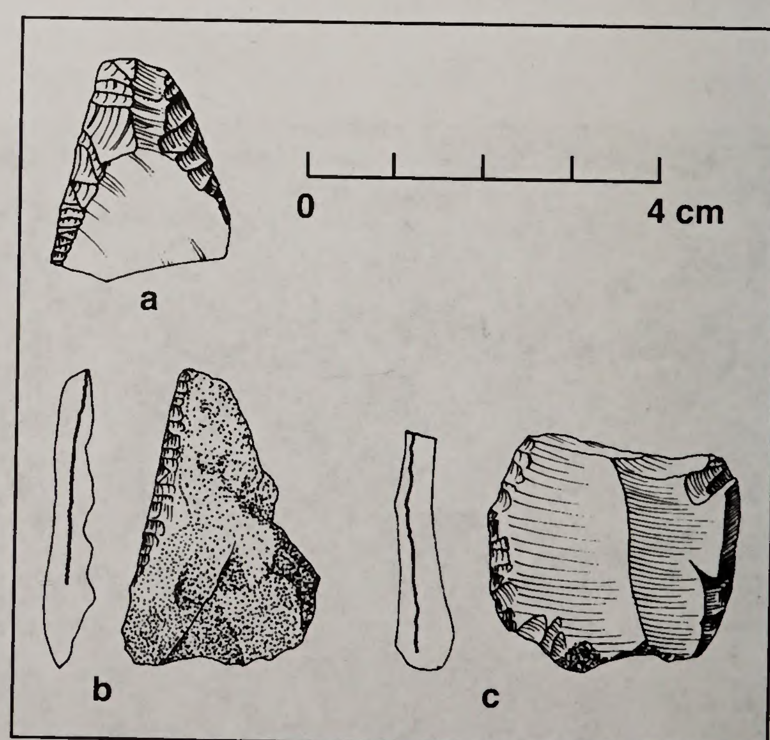



Figure 21. Prehistoric edge-retouched flakes from Study Area sites 24VL254, 24VL408, and 24VL380.

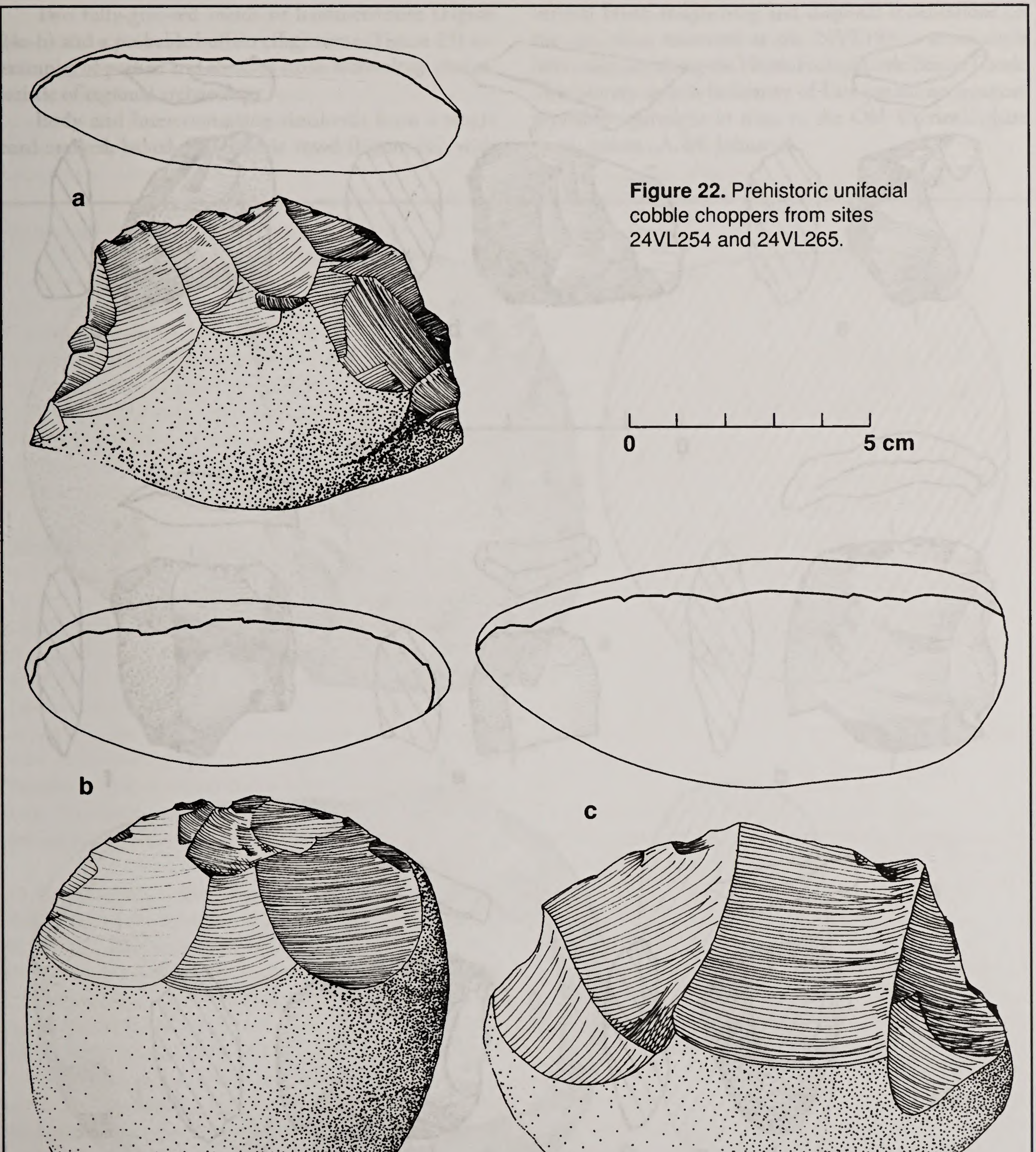



**Figure 22.** Prehistoric unifacial cobble choppers from sites 24VL254 and 24VL265.

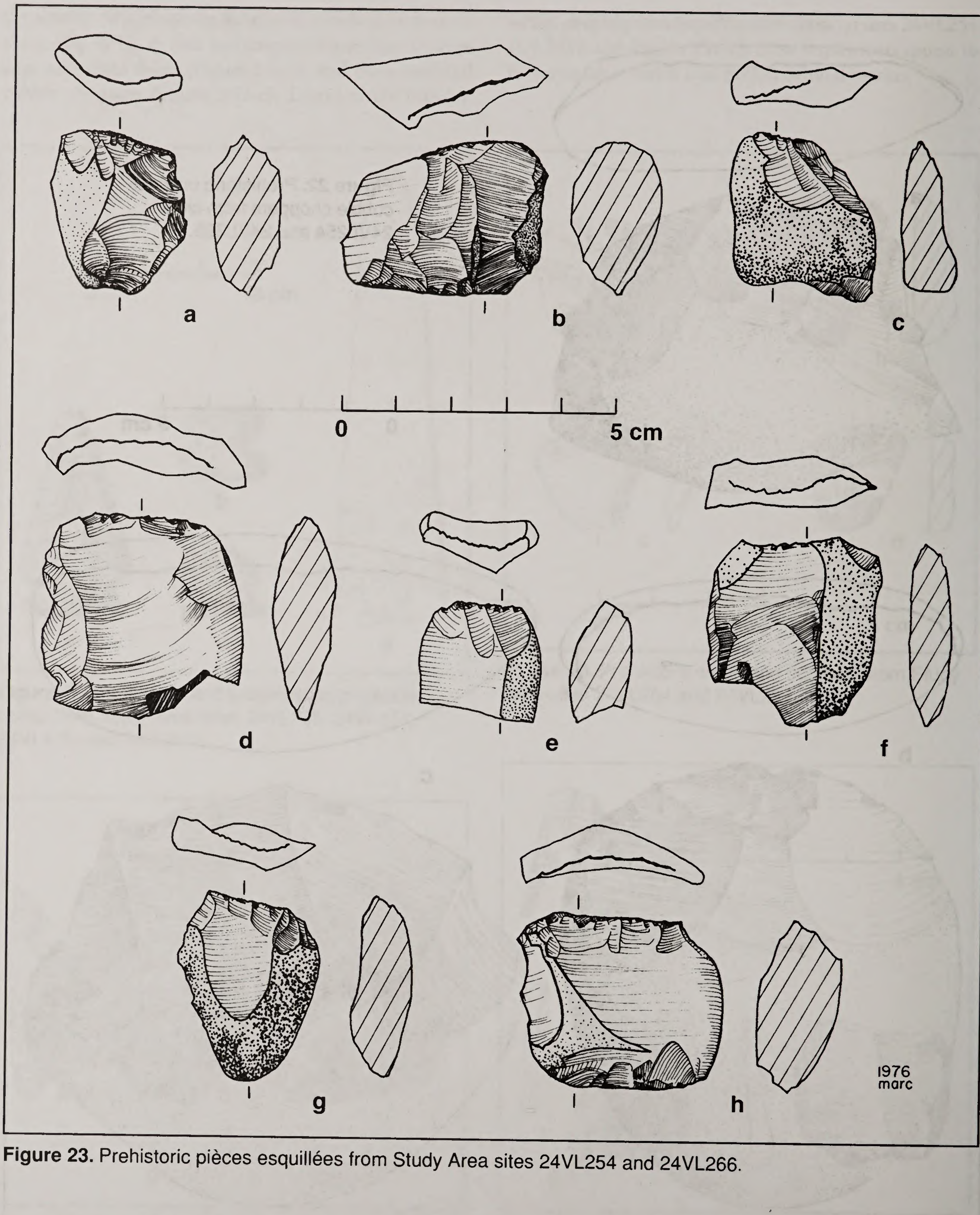



**Figure 23.** Prehistoric pièces esquillées from Study Area sites 24VL254 and 24VL266.

Two fully-grooved mauls or hammerstones (Figure 24a-b) and a probable buffalo effigy stone (Figure 25) are examples of pecked and abraded stone technology characteristic of regional archaeology.

Body and interconnecting rimsherds from a single cord-marked, baked clay ceramic vessel (Figure 26), with vertical brush roughening and diagonal indentations on the rim, were recovered at site 24VL193, a stone circle habitation site along the North Fork of Little Beaver Creek. This pottery style is indicative of Late period occupation, probably equivalent in time to the Old Women's phase (pers. comm., A. M. Johnson).

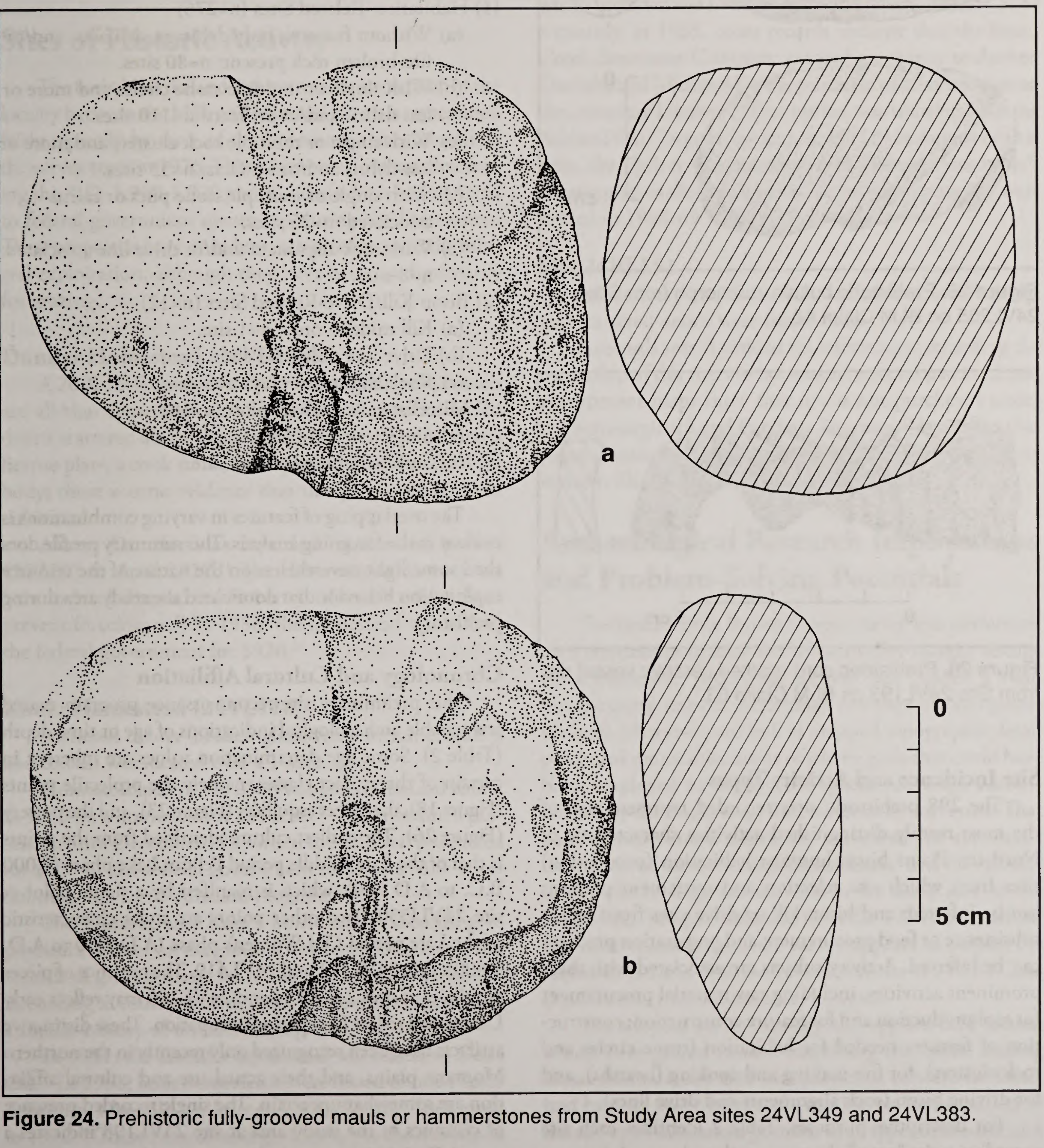



**Figure 24.** Prehistoric fully-grooved mauls or hammerstones from Study Area sites 24VL349 and 24VL383.

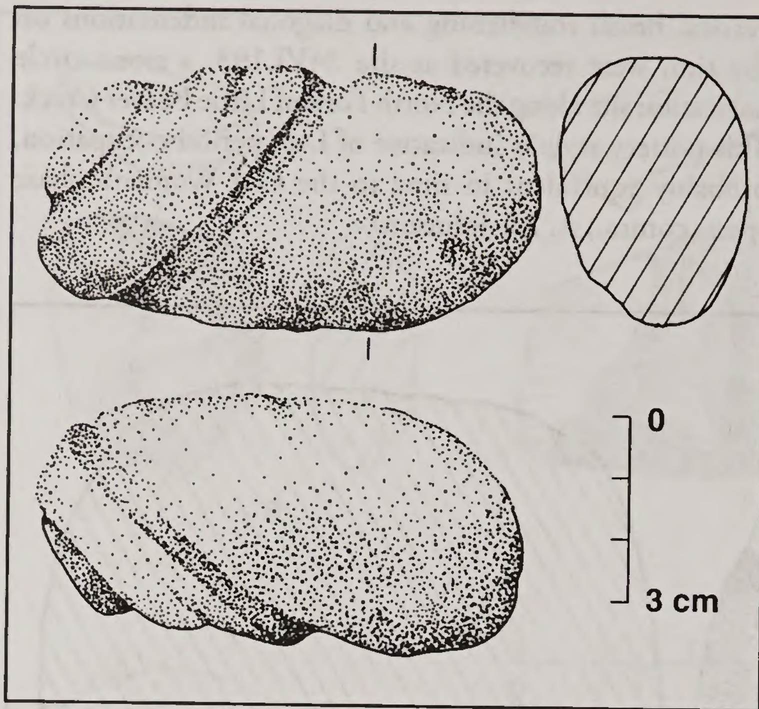



**Figure 25.** Prehistoric buffalo zoomorph from Site 24VL265 on BLM Claim 42.

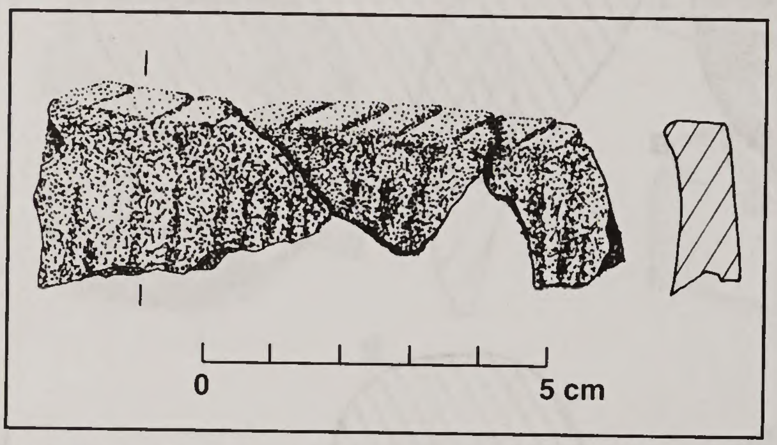



**Figure 26.** Prehistoric cord-marked ceramic vessel rim from Site 24VL193 on BLM Claim 63.

## Site Incidence and Activity Types

The 298 prehistoric sites recorded represent two of the most readily distinguished activities characteristic of Northern Plains bison hunters: habitation (occupation) sites from which site selection and settlement patterns can be inferred; and bison kill or drive sites from which subsistence or food procurement and preparation practices can be inferred. Activity subsets are associated with these prominent activities, including raw material procurement for tool production and for feature construction; construction of features needed for habitation (stone circles and rock clusters), for fire-making and cooking (hearths), and for driving bison (rock alignments and drive lines).

For descriptive purposes, Table 2 identifies each site according to its "type;" the types are based upon inferences drawn from the presence of features and, less often, other artifacts that represent hypothesized uses. The following data show the frequency distribution of these site "types" in the study area. In the past reality, all of these activities were intimately associated; hence, the obvious difficulty of isolating groups of features into exclusive behavioral categories:

(1) Habitation-Related Sites (n=276)
- (a) Without features; only debitage, artifacts, and/or fire-broken rock present: n=80 sites.
- (b) With single or multiple stone circles and more or less debris and/or artifacts: n=110 sites.
- (c) With single or multiple rock clusters and more or less debris and/or artifacts: n=53 sites.
- (d) With single or multiple stone piles or cairns associated: n=25 sites.
- (e) With rock alignment and/or drive line associated: n=8 sites.

(2) Bison Kill/Drive-Related Sites (n=12)
- (a) Kill midden only: n=1 site.
- (b) Drive line only: n=3 sites.
- (c) Rock alignment only: n=8 sites.

(3) Miscellaneous Activity Sites (n=10)
- (a) Single cairn: n=9 sites.
- (b) Surface depression: n=1 site.

The overlapping of features in varying combinations is evident in the foregoing analysis. This summary profile does shed some light nevertheless on the nature of the resource exploitation behavior that dominated the study area during prehistory.

## Chronology and Cultural Affiliation

This preliminary site reconnaissance program netted few reliable archaeological indications of age or time depth (Table 2). Some age determination values are inherent in certain of the artifact classes, namely the projectile points (Figure 18), the pièces esquillées (Figure 23), and the pottery (Figure 26). The earliest culture identified from the points is that of the Late Middle period Pelican Lake phase (1,000 B.C. to A.D 200), which is manifest by a single point at site 24VL1350. Two other points are styles characteristic of the Late period Old Women's phase (A.D. 750 to A.D. 1,800): sites 24VL171 and 24VL419. The presence of pièces esquillées at sites 24VL254 and 24VL266 may reflect early Late period to late Late period occupation. These distinctive artifacts have been recognized only recently in the northern Montana plains, and their actual use and cultural affiliation are somewhat uncertain. The single recorded presence of ceramics in the study area at site 24VL193 indicates a post-A.D. 1,500 Late period occupational event.

Based upon a comparison with evidence elsewhere in the Northwestern Plains, it is probable that many of the sites in the study area reflect land use during the Late Prehistoric period. Physical evidence of earlier prehistoric use, particularly in the form of characteristic artifacts, may have been removed prior to the survey by such thoroughgoing collectors as sheepherders.

## Sites of Historic Activity

The basic historic land-use pattern characteristic of the locality between the Milk and Missouri Rivers is represented fairly typically by three of the five historic sites located by the survey team in 1976. These sites were homesteaded during the A.D. 1,910-1,920 period, all of which had reverted to federal government ownership during the Depression. These properties have since been subjected to sporadic mineral exploitation, although they have been used primarily for grazing.

### Dunifer Homestead (24VL108)

A 20 X 15-ft cement foundation and cellar depression are all that remain of this homestead. Surveyors found debris scattered about the site, including a 1929 Montana license plate, a cook stove, and a junked Model-T Ford car body; there was no evidence that this property had been cultivated.

Albert Dunifer was awarded homestead patent #582207 in April 1917.[31] The claim was sold two years later to Jacob Patton and Robert J. Moore,[32] evidently to prevent foreclosure.[33] In 1936, the homestead was sold to the federal government for $920.[34]

### Kuner Homestead (24VL118)

Scattered debris (broken glass, scrap metal, crockery, and bricks) was located over a 1-acre area.

Homestead patent #772586 was granted to Carl Kuner in 1920 for a homestead of 280 acres.[35] Kuner retained possession until December 1935 when the land was purchased for $620 by the federal government under the Milk River Submarginal Land Purchase Program.[36]

The Dunifer and Kuner homesteads, according to physical evidence on the ground, were used for grazing, but records of grazing leases let in the past are not available.[37] According to county records, both homesteads experienced a similar history of mineral leasing.

In 1951, the Dunifer homestead was leased to Delhi Oil.[38] In 1968, both homesteads were leased to one Nancy Anschutz, who sold her lease to Lockridge and Thompson in 1972.[39] These were oil and gas leases, but the records do not indicate whether exploration occurred.

Interest in bentonite extraction here developed at least as early as the 1960s. The actual date of a lease could not be located; county records do show an Affidavit of Assessment Work performed by the Brazil Creek Bentonite Company between 8 September and 31 October 1962. Road building, surveying, and core drilling valued at $11,300 were accomplished by that company on 99 claims in the area, which included the Dunifer and Kuner homesteads.[40] Subsequently, in 1965, court records indicate that the Brazil Creek Bentonite Company granted an option to Archer, Daniels, and Midland for the purchase of all bentonite on the company's claims.[41] That option was transferred to the Ashland Oil Corporation in July 1971;[42] in August of that year, the option was transferred to Federal Bentonite.[43] "Numerous shallow drill holes," to test the bentonite, were drilled in 1968-69.[44]

### Site 24VL151

A foundation, a collapsed tin-roofed shed, a well casing, and scattered debris were found here.

A records search yielded no information regarding the ownership of this site. No homestead was ever patented, and government maps show that it was not purchased under the Submarginal Land Purchase Program.[45] It appears that persons unknown may have "squatted" on the property without filing a formal claim.

## Archaeological Research Implications and Problem-Solving Potentials

The Brazil/Little Beaver Creeks survey was performed on a continuous upland and stream valley margin acreage via a systematic, pedestrian method that yielded a high, but inexactly known, percentage coverage of contiguous surfaces. Map scale and lack of mapped topographic detail precluded the establishment of survey grids that could have been employed to display the specific coverage accomplished by the single-stage foot traverses by surveyors. That basic record control deficiency prevented the systematic estimation of survey "comprehensiveness" and the calculation of the heritage site universe in the study area on the basis of the "sample" obtained from the 1976 survey effort. The relative intensity of the survey appears to surpass the requirements and described characteristics of a BLM Class II preliminary reconnaissance, however.

The adopted survey strategy and applied field tactics, which were geared toward examining the entire mining claim-defined study area with particular concern for localized hazards posed by specific mining pit locations, led to the survey of substantial portions of all types of site-free and site-bearing terrain. Consequently, we are of the opinion

that available survey tract heritage manifestations, their relative occurrence in space, their baseline condition, and their information value profile are representative of those which were not inventoried in the process. Known sites may well account for as much as 70 to 80 percent of all comparable manifestations in the study tract. Some of the single, isolated, low-profile features and widely distributed artifacts were undoubtedly bypassed or otherwise overlooked during the survey.

Some of the data implications for settlement analysis are fairly clear. However, the derivation of settlement patterns requires the careful description of settlement-related features accompanied by a study of their spatial relationships within explicitly distinguished local ecotypes. The abundance of settlement-related sites in the study area and the presence of multiple ecotypes offers broad potential for such study.

The arbitrary, industrial definition of the surveyed surface can be translated into a hypothesis-building type of situation. Use of the resultant data for hypothesis testing is less acceptable. The survey afforded an opportunity to develop a sample of all available information classes. Those records can now serve as a necessary descriptive and locational observation increment to an information base that is gradually developing in the northern Montana sector of the Northwestern Plains.

Those kinds of basic, long-range research goals notwithstanding, the findings of the 1976 survey did contribute certain information values that add materially to a presently bleak and fragmentary record and also posed testable questions and research questions, of which the following are the most salient:

(1) Only one previous occurrence of pièces esquillées has been reported in northern Montana, at the Old Women's phase Thompson Bottom site (24CH452) in the Missouri Breaks area to the southwest (Davis 1976). Two more occurrences are present in the study area.

(2) The recognition of morphologically distinct circular stone structures, named here "rock clusters" to distinguish them from stone circles (tipi rings) until their relationship can be studied more closely. Problem-oriented implications, seasonal and/or cultural, are unclear. These features may offer yet another stimulus that will provoke a re-examination of prevailing settlement assumptions and conclusions. The detailed mapping of stone circles in relation to other stone circles, rock clusters in relation to other rock clusters and to stone circles, and drive lines in relation to stone circles and rock clusters might elicit critical settlement patterns.[46]

(3) Detailed analysis of artifacts and collected lithic debitage, for the purpose of isolating the exotic lithics present at 53 (17.4 %) of the sites, may prove useful in routine distributional studies. For example, a distinctive brown chalcedony believed to derive from quarries in western North Dakota is present in small quantity at several sites, as are siltstone, mudstone, and porcellanite specimens that may represent lithic transport over distances from externally located quarries.[47]

(4) Certain of the well-preserved stone circle and rock cluster concentrations offer excellent potential for the development of detailed records of sub-surface aspects by which to augment mapped surficial observations.

# Evaluation and Assessment of Heritage Values

## Baseline Condition

Site surveyors noted and recorded the present condition or integrity of cultural deposits in evidence at each heritage site. Table 3 lists those conclusions that were, in the majority of instances, based solely upon surficial indicators; buried remains were observed in buried crosssection only rarely in the cutbanks of arroyos. One hundred and thirty sites (43%) are considered to be well-preserved or are relatively undisturbed by natural and human agencies.

More than half (57%) of the study area sites had been disturbed, from slightly to severely. Of these 173 sites, disturbances at 112 (64 %) are attributed to erosional processes that deflated and incised surfaces to expose and alter the "original" positions of features and artifacts therein or thereon; over half of these sites (n=59) are actively eroding at the present time. Other than the extensive surface removal of isolated artifacts, the occasional destruction of roadside stone piles and cairns and central features in stone circles by collectors, and the dis- ruptive effects of recent road, trail, and railroad construction activities, site disturbance is attributed principally to erosional and weathering agencies.

## Evidentiary Limitations and Site Evaluation Criteria[48]

The physical indicators employed here as the evidence upon which the evaluative criteria were applied to heritage sites, as a means of determining their relative informational value, present certain limitations. These indicators derive from a preliminary surficial reconnaissance designed principally to identify and locate heritage manifestations. The in-field observational process yielded only "impressions" of subsurface manifestations since subsurface testing was not performed. The overall impression of the study area, in terms of its characteristic potential as a "container" of subsurface cultural deposits, is one of limited potential. Examination of countless high to low elevation arroyos and stream banks with negative results led to that impression. Accumulation of wind-borne sediments on the uplands in recent times, since prehistory, has been scant. Erosional processes characteristically expose rather than bury features and artifacts, although that pattern does have its local exceptions. Therefore, a subsurface program was not necessary to fulfill the objectives of the present evaluation.

The following assessment criteria were applied to the limited physical evidence available in the Brazil/Little Beaver Creeks study area:[49]

(1) Depth. Property shows definite indication of preserved cultural and/or paleoecological materials and, given the necessary resources, reliable chronological controls (absolute or relative) have been or can be established by stratigraphic and/or chronometric methods. Comment: This criterion is not strictly applicable to the shallow, surficially evident cultural deposits characteristic of the study area. While cultural stratigraphy was present, in a few instances, stratification of multiple, sequential cultural deposits was not observed.

(2) Architectural Features. Low-profile features such as stone circles, rock clusters, stone piles, cairns, rock alignments, hearths, fire-cracked rock, a surface depression, and drive lines and lanes are abundant. However, few appear as complex, interrelated series of structures.

(3) Artistic Features. Not applicable.

(4) Size. Estimated acreage per site is a high-uncertainty parameter for site assessment. A decision to group features into a discrete site or sites is often arbitrary and indefinite, given the present dearth of knowledge by which, for example, stone circles are grouped or divided into greater or lesser spatial entities based upon the principle of geographic proximity. Size was considered a contributing factor of importance only in relation to the relative expanse of space occupied by extensive stone circle encampments and drive lines.

(5) Age. This criterion was only useful in the evaluation of a few sites; antiquity per se is not a particularly relevant factor in the study area.

(6) Permanency. Lack of stratification made it difficult to demonstrate the repeated occupation of single sites. Moreover, Northwestern Plains occupation sites are characterized by short-term, often seasonal occupation.

(7) Uniqueness. Unique sites do not appear as individual sites. The rock cluster features approach the unique as a widespread manifestation; however, future research may show that they occur elsewhere in comparable numbers.

(8) Association. Not applicable (even to the historic sites).

(9) Representativęness. Representative sites are either type sites or particularly well-preserved examples of events that represent specific archaeological cultures. Comment: Certain habitation and bison drive sites do meet this criterion.

(10) Condition. This is a critical factor by virtue of the particular erosional/depositional character of the study area.

(11) Problem Orientation. The role that some sites may play conceivably in relation to resolving prevailing professional research problems is clear. In other instances, where very basic questions are regarded as research problems (such as subsistence, resource utilization, and settlement patterns), few sites are totally lacking in information that could have some kind of a bearing on certain problems.

Each site was considered individually and studied against the backdrop provided by the foregoing assessment criteria as a step toward the derivation of a significance rating level for each site.

## Significance Criteria Applied to Specific Sites[50]

Ratings for the prehistoric sites were made by reference to national and regional significance, since state and local significance apply more properly to events at historical sites. The significance rating for each site was derived by forcing each site, by reference to its evaluated attributes, into the most appropriate significance category or level:

Sl properties have already yielded highly significant scientific, educational, and recreational information, and they are clearly important in terms of national and regional (prehistoric sites) and state or local (historic sites) cultural events. These properties typically have buried manifestations (single or multiple component) or surface features that are relatively well-preserved and are either unique or representative and display one or a combination of assessment attributes 1 through 6. Sl properties are considered eligible for nomination to the National Register.

S2 properties include those which, by reason of preservation by burial (single or multiple component historic and/or prehistoric sites), hold high potential for yielding significant information values; some may be elevated to Sl upon further evaluation. These properties are, when taken at face value, potentially unique and representative. Condition may be highly variable and difficult to assess consistently and reliably. Some of the S2 properties are valued essentially because of the extensive surface area they occupy, but this criterion is of only secondary importance. Antiquity may be comparable and relatable to that known or estimated at Sl sites, whether or not antiquity per se is considered important. Limited depth of burial is characteristic of local deposits; thus, depth or burial along is not regarded as a necessary limitation of S2 sites.

S3 properties are valued primarily for their potential for contributing data toward the solution or testing of basic problems such as settlement pattern, resource utilization, and paleoenvironmental reconstruction. These properties typically have little depth, if any, but they may have many features. They may show more than minimal time depth (due to deep exposure by erosion), and they may be localized or extensive. They usually lack definite concentrations of evidence other than features and lithic waste. Most S3 sites are seasonally occupied habitation sites at or near locations where hunting and gathering occurred. Few S3 sites hold potential for upgrading by further work to S2 or Sl.

S4 properties possess minimal information values and little retrieval potential, such that few, if any, additional records of value can be developed at these sites given the present ability and readiness of responsible agencies to commit funds for the preservation of cultural resources that qualify at this low value level.

Rigorous, but realistic assignments of each of the 303 Brazil/Little Beaver Creeks sites to the most appropriate significance level (Table 3) resulted in the following incidence of sites per significance level: 4, or 1.3 percent, Level l; 33, or 10.9 percent, Level 2; 146, or 48.3 percent, Level 3, and; 120, or 39.5 percent, Level 4. The frequency distribution of low information values at S4 sites reflects the often only superficial present knowledge of many sites. Many of the S3 sites derive their relative importance from their settlement pattern implications. The modest occurrence of S2 sites is strongly influenced by the absence of buried, stratified deposits, but is offset somewhat by the abundance of potentially very informative rock cluster sites. The low incidence of Sl sites, only 1.3 percent, also reflects the scarcity of buried deposits with high informational potentials; Sl sites are distinguished here due to their size or scale and the number of interrelated features present at each.

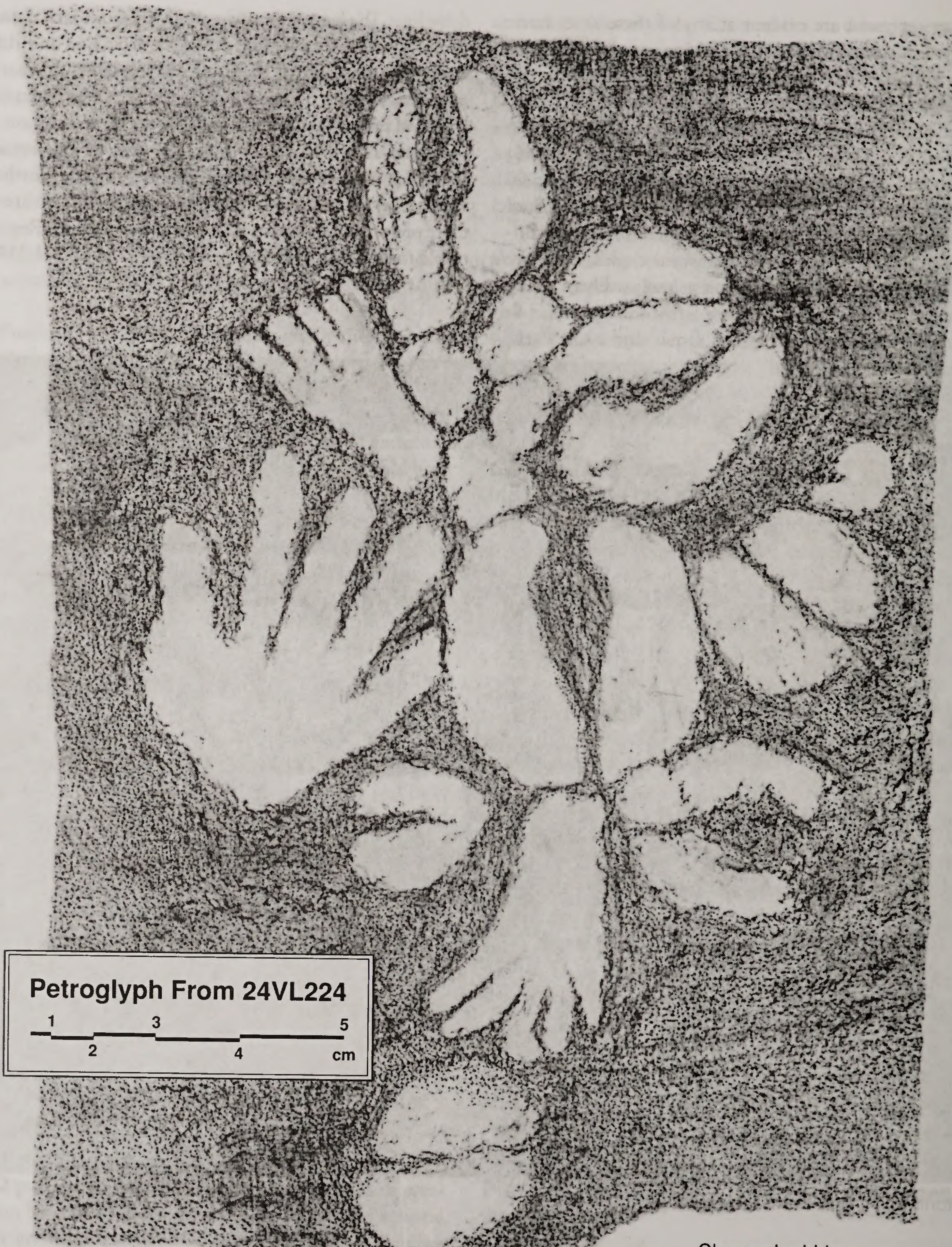
## National Register of Historic Places Eligibility

None of the five historic sites identified in the Brazil/ Little Beaver Creeks study area qualify for listing on the National Register of Historic Places. Since no restorable, standing physical remains which are characteristic of the

era they represent are evident at any of these sites, none qualify for listing in the State of Montana Inventory of Historic Sites.[51]

Only four of the 298 archaeological sites qualify for a Level 1 significance rating. Of these sites, 24VL352 (state, 80 acres) and 24VL395 (federal, 30 acres) are relatively undisturbed extensive habitation sites characterized by 50 and 75 preserved stone circles, respectively, with associated surficial lithic debris. Site 24VL238 (federal, 40 acres) consists of a drive line with 32 adjacent stone circles, while site 24VL115 (federal, 300 acres) consists exclusively of a long drive line. The large habitation sites with numbers of stone circles and the simple, but extensive drive line and drive lane systems constitute the most scientifically informative manifestations in the study area by reference to settlement and food procurement activities. Study and preservation are recommended. Because of their size, state of preservation (high integrity), and their values as representative Northern Plains cultural manifestations, we recommend that three of these prehistoric sites be nominated to the National Register of Historic Places: 24VL352, 24VL395, and 24VL238.

Bentonite mining and processing in progress




Charcoal rubbing
(by Marc B. Smith)

# Protection of Potentially Affected Heritage Values

## General Implications of Current Mining Projections

Figure 4 displays the mining pit locations projected by Federal Bentonite as of summer 1970. Pit locations were provided by the Company only for the federal mining claims; the mapped state leases do not specify probable or potential mining pit locations.[52]

Because of the fragile nature of local archaeological resources, all forms of disturbance associated with bentonite mining will be irreversible. Removal of bentonite could have direct adverse effects if sites are eliminated or partially degraded or destroyed by mining, stockpiling, and related operations at designated locations and within projected location limits. Road-building and other land-disturbing actions associated with gaining access to and from the mines would constitute indirect effects. Increased accessibility made possible by new roads could increase public use of the area, thereby putting additional collecting pressure on local archaeological and paleontological manifestations.

## Impact Estimation at Specific Heritage Sites

The relative or absolute geographic proximity of identified sites to projected pit locations was the sole criterion applied here as a measure of probable impact. Reliance upon the practical planning implications of impact estimation and mitigation based thereon should be tempered by recognition of the uncertainty that attends the location of certain heritage sites. The presumption of relative proximity should even out statistically, however, across a number of ostensibly affected sites.

Figure 4 displays the mining pit and heritage site locations, and Table 3 specifies the postulated Effect of Action based upon the assumption that mining will occur where indicated. Effects are considered unknown when identified sites are more than .25 mi (.4 km) from pit edge. From .25 mi to the near vicinity of pit edge, indirect effects are anticipated as probable. Direct effects are predicted when known sites occur within or immediately adjacent to designated pits. This rather hypothetical approach disallows the prediction of degrees of effect since that kind of precision potential is absent from the locational data.

The principal effect of the anticipated action (Table 3) cannot be known at 215, or 71 percent, of the heritage sites. Indirect detrimental effect can be anticipated to an acceptable degree at 70, or 23.1 percent, of the study area sites, while direct effects are predictable at 18, or 5.9 percent, of the sites. The 70 indirectly affected sites occur on 42 mining claims, while the 18 directly affected sites occur on 15 claims; both directly and indirectly affected sites occur on 10 mining claims.

## Avoidance as the Preferred Action Alternative

Irrespective of its present condition, informational values, and estimated significance, be disturbed or altered. The extent to which projected mining plans can conceivably be adjusted or accommodated to avoid indirect or direct impacts at potentially threatened sites is not known. Since we are not in a position to evaluate the possibility of avoidable impacts, we will proceed as though predicted impacts are unavoidable, but to an unknowable degree of detrimental effect, which will require mitigation.

## Mitigation Recommendations For Unavoidable Heritage Site Impacts

Actions recommended to reduce the loss of irretrievable cultural values to an "acceptable minimum" are keyed to the nature of the anticipated effect (indirect or direct) and to the significance level rating assigned to each affected site. The overall "threat" to cultural resources, as a consequence of mining actions, can be inferred from the following figures taken from Table 3: Significance Level 1 sites (n=2): 100 percent indirect; Significance Level 2 sites (n=13): 77 percent indirect, 23 percent direct; Significance Level 3 sites (n=34): 85 percent indirect, 15 percent direct, and; Significance Level 4 sites (n=39): 74 percent indirect, 26 percent direct.

Table 3 lists the closing recommendations for each identified site. A recommendation of "None" was filed for sites in those instances where the mining action presents no foreseeable harm (n=215), or, in the case of estimated adverse affect, where some kind of mitigating action is not warranted by the significance level rate and condition of the affected site (n=24). "None" was the disposition of 239, or 79 percent, of the Brazil/Little Beaver Creeks heritage sites.[53] Of the 64 other sites for which impact predictions are active, the mapping of surficial features is recommended

at 40 sites, mapping augmented by test excavation at 23 sites, and excavation at one site. The recommended mitigation actions specified in Table 3 are appropriate to and contingent upon the circumstances presented by the anticipation of bentonite mining at specified locations in relation to specific sites. Any future change of pit locations will alter proximity; such changes might be cause for a reappraisal of proximity, impact, and protective recommendations.

Recommended surficial mapping programs should be detailed and comprehensive so as to yield a reliable document of feature configurations. The scale, scope, and intensity of subsurface testing programs should be designed to fit each specific situation. Mitigation of indirect effect requires a less complete record than is needed for direct effect situations where the developed record will be the only surviving manifestation.

## Disposition of Paleontological, Archaeological, and Historical Records and Specimens

Field maps, notes, 35-mm slides, and black-and-white positives and negatives, assorted fossils and historical objects, and catalogued prehistoric artifacts were transferred from the Museum of the Rockies at MSU to the Billings Curation Facility operated by the BLM.

## Summation

A record search and ground-truth investigation was performed from late summer to early winter of 1976, of federal and state lands within 114 bentonite mining claims under lease by Aurora Metal Company in southwest Valley County, northeastern Montana.[54] The leased area, parts of which will be affected by projected bentonite mining activities, comprises 20,400 acres of weathered upland terrain drained by Brazil and Little Beaver Creeks.

Local geology, geomorphology, and geohydrology reveal that the surface of the study area has been intermittently modified by ongoing erosion; natural effects of disturbance have been aggravated by the disruptive effects of livestock grazing, vehicular traffic, road and railroad construction, and exploration for and extraction of bentonite. Also, artifacts were collected from many parts of the surface, and certain of the surficial features were potted by artifact collectors and inquisitive others prior to the inventory. These agencies of disturbance have combined to create a dynamic and vulnerable landscape in which only 43 percent of the identified cultural heritage sites have escaped degradation.

Three hundred and three discrete sites of prehistoric activity (n=298) and recent historic activity (n=5) were inventoried on-the-ground on 102 of the 114 mining claims, between 27 July and 17 August, by a survey team from Montana State University. The inventoried prehistoric sites represent activities associated with settlement (habitation), food procurement (bison kill/drives), raw material procurement and tool production, and ceremonial systems. Observed archaeological features include: fire-broken rock; hearths; stone circles; rock clusters; cairns; stone piles; drive lines; rock alignments; and surface depressions. Recovered prehistoric artifacts include: projectile points; knives (bifaces); pièces esquillées; end scrapers; edge-retouched flakes; hammerstones; choppers; a zoomorphic stone effigy; lithic waste; and earthenware ceramics.

The 303 heritage sites were evaluated and assigned significance levels (CRES) in accord with established criteria to determine their relative national importance as cultural resources. Four (1.3%) Level 1 prehistoric sites are sufficiently important to warrant nomination to the National Register of Historic Places; however, only three of these sites are recommended for nomination. Thirty-three (10.9%) sites are significant at Level 2, 146 (48.3%) at Level 3, and 120 (39.5%) at Level 4; certain of these sites merit perspective procedures.

The effect of bentonite mining cannot be predicted at 215 (71%) of the heritage sites, since these sites occur at distances greater than .24 m from projected pit locations or because pit locations (on state lands) were not specified by the Company. Indirect detrimental effect is anticipated at 70 (23.1%) sites in the study area, and direct impact is predicted at 18 (5.9%) sites. The indirectly affected sites distribute on 42 mining claims, while the directly affected sites occur on 15 claims; both indirectly and directly affected sites are located on 10 claims.

Avoidance of potentially adversely affected sites is the preferred action alternative. However, since the practicality and feasibility of avoidance as an alternative remains a matter for future determination between the Company and public land managers, recommendations specify the most effective mitigation approach as though each projected pit location will be mined as planned. Further action to preserve and protect affected sites is not required at 239 (79%) of the heritage sites. The mapping of surficial features is recommended at 40 sites, mapping augmented by test excavation at 23 sites, and excavation at one site. Recommended mitigation procedures are appropriate to and contingent upon the circumstances presented by anticipated mining actions at specified locations. Since any future changes in pit location will alter the proximity relationship between identified sites and mined locations, such changes may be cause for a reappraisal of proximity, impact, and the advisability of protective action on the part of the Company.

## Postscript

A follow-up site reconnaissance and testing program was conducted in behalf of Aurora Metal Company in response to the original investigation in order that the company might proceed to mine bentonite: "Follow-up Ground-Truth Reconnaissance, Evaluation and Protection of Cultural Resource Sites on Aurora Metal Company Bentonite Mining Claims in Southwest Valley County, Montana," by L. B. Davis, submitted to Ecological Consulting Service, Inc. in behalf of the Aurora Metal Company, Federal Bentonite Division, July 1977.

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## Appendix 1. Archaeological and Historical Sites in the Brazil Creek and Little Beaver Creeks Drainage Area: Identification, Location, Natural Setting, and Area.

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| 69 | S-10 | 24VL101 | Engstrom | Brazil Creek | 2240′ | small |
| 69 | S-28 | 24VL102 | Engstrom | Brazil Creek | 2270′ | .25 |
| 69 | S-38 | 24VL103 | Engstrom | Brazil Creek | 2280′ | 1 |
| 69 | S-50 | 24VL104 | Engstrom | Brazil Creek | 2250′ | 1 |
| 69 | S-12 | 24VL105 | Engstrom | Brazil Creek | 2298′ | small |
| 69 | S-49 | 24VL106 | Engstrom | Brazil Creek | 2300′ | 1 |
| 69 | S-ll | 24VL107 | Engstrom | Brazil Creek | 2275′ | small |
| BLM "A" | S-8 | 24VL108 | Engstrom | Brazil Creek | 2275′ | 100 |
| BLM "A" | S-48 | 24VL109 | Engstrom | Brazil Creek | 2270′ | small |
| BLM "A" | S-18 | 24VL110 | Engstrom | Brazil Creek | 2220′ | small |
| BLM "A" | S-9 | 24VL111 | Engstrom | Brazil Creek | 2300′ | 5 |
| BLM "A" | FS-1 | 24VL413 | Engstrom | Brazil Creek | 2230′ | small |
| 68 | S-l9 | 24VL112 | Engstrom | Brazil Creek | 2280′ | small |
| 68 | S-13 | 24VL113 | Engstrom | Brazil Creek | 2310′ | small |
| 68 | S-130 | 24VL114 | Engstrom | Brazil Creek | 2320′ | .25 |
| 67 | S-6 | 24VL115 | Engstrom | Brazil Creek | 2240′-2350′ | 300 |
| 70 | S-20 | 24VL116 | Engstrom | Brazil Creek | 2290′ | small |
| 70 | S-70 | 24VL117 | Engstrom | Brazil Creek | 2285′ | small |
| BLM "B" | S-31 | 24VL118 | Engstrom | Brazil Creek | 2280′ | 1 |
| BLM "B" | S-56 | 24VL119 | Engstrom | Brazil Creek | 2250′ | .5 |
| BLM "B" | S-57A | 24VL120 | Billick | Brazil Creek | 2260′ | .5 |
| BLM "C" | S-41 | 24VL121 | Billick | Brazil Creek | 2300′ | 1 |
| BLM "C" | S-53 | 24VL122 | Billick | Brazil Creek | 2300′ | 3-5 |
| BLM "C" | S-52 | 24VL123 | Billick | Brazil Creek | 2325′ | 5 |
| School Lease "A" | S-51 | 24VL124 | Billick | Brazil Creek | 2300′ | 2.5 |
| School Lease "A" | S-40 | 24VL125 | Billick | Brazil Creek | 2300′ | .25 |
| School Lease "A" | S-58 | 24VL126 | Billick | Brazil Creek | 2260′ | .5 |
| School Lease "A" | S-59 | 24VL127 | Billick | Brazil Creek | 2290′ | small |

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| School Lease "A" | S-57B | 24VL128 | Billick | Brazil Creek | 2255′ | small |
| School Lease "A" | S-32 | 24VL129 | Billick | Brazil Creek | 2100′ | small |
| School Lease "A" | S-22 | 24VL130 | Billick | Brazil Creek | 2285′ | small |
| School Lease "A" | S-61 | 24VL131 | Billick | Brazil Creek | 2330′ | small |
| School Lease "A" | S-l | 24VL132 | Billick | Brazil Creek | 2390′ | 5 |
| School Lease "A" | S-33 | 24VL133 | Billick | Brazil Creek | 2330′ | .5 |
| School Lease "A" | S-63 | 24VL134 | Billick | Brazil Creek | 2330′ | small |
| 1 | S-55 | 24VL135 | Billick | Brazil Creek | 2310′ | 5 |
| 1 | S-54 | 24VL136 | Billick | Brazil Creek | 2350′ | 1 |
| 1 | S-43 | 24VL137 | Billick | Brazil Creek | 2350′ | 2 |
| 1 | S-42 | 24VL138 | Billick | Brazil Creek | 2340′ | .25 |
| 1 | S-2 | 24VL139 | Billick | Brazil Creek | 2330′ | .5 |
| 1 | S-44 | 24VL140 | Billick | Brazil Creek | 2330′ | .25 |
| 2 | S-62 | 24VL141 | Billick | Brazil Creek | 2330′ | .5 |
| 3 | S-45 | 24VLl42 | Billick | Brazil Creek | 2310′ | .5 |
| 3 | S-116 | 24VL143 | Billick | Brazil Creek | 2300′ | small |
| 3 | S-67 | 24VL144 | Billick | Brazil Creek | 2325′ | small |
| 3 | S-64 | 24VL145 | Billick | Brazil Creek | 2355′ | .5 |
| 3 | S-65 | 24VL146 | Billick | Brazil Creek | 2335 | small |
| 3 | S-66 | 24VL147 | Billick | Brazil Creek | 2330′ | small |
| 5 | S-68 | 24VL148 | Billick | Brazil Creek | 2325′ | small |
| 5 | S-46 | 24VL149 | Billick | Brazil Creek | 2350′ | small |
| 6 | S-23 | 24VL150 | Billick | Brazil Creek | 2370′ | 5 |
| 9 | S-69 | 24VL151 | Billick | Brazil Creek | 2320′ | 10 |
| 10 | S-47 | 24VL152 | Billick | Brazil Creek | 2300′ | 2 |
| 11 | S-80 | 24VL153 | Billick | Brazil Creek | 2330′ | .5 |
| 11 | S-79 | 24VL154 | Billick | Brazil Creek | 2340′ | .5 |
| 12 | S-84 | 24VL155 | Billick | Brazil Creek | 2370′ | 1 |
| 12 | S-81 | 24VL156 | Billick | Brazil Creek | 2380′ | .5 |
| 12 | S-78 | 24VL157 | Billick | Brazil Creek | 2310′ | 2.5 |
| 12 | S-83 | 24VL158 | Billick | Brazil Creek | | small |
| 12 | S-82 | 24VL159 | Billick | Brazil Creek | | .5 |
| 118 | S-87 | 24VL160 | BLM | Brazil Creek | | 10 |
| Plant Site | S-75 | 24VL161 | BLM | South Fork Brazil Creek | | 2 |
| Plant Site | S-99 | 24VL162 | BLM | South Fork Brazil Creek | | 10 |
| School Lease "B" | S-74 | 24VL163 | BLM | Brazil Creek | | small |
| School Lease "B" | S-73 | 24VL393 | BLM | North Fork Little Beaver Creek | | small |
| 21 | S-89 | 24VL164 | BLM | North Fork Little Beaver Creek | | small |
| 21 | S-34 | 24VL165 | BLM | North Fork Little Beaver Creek | | small |
| 21 | S-102 | 24VL166 | BLM | North Fork Little Beaver Creek | | 5 |
| 18 | S-110 | 24VL394 | BLM | North Fork Little Beaver Creek | | small |

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| 19 | S-108 | 24VL167 | BLM | North Fork Little Beaver Creek | | 1 |
| 19 | S-77 | 24VL168 | BLM | North Fork Little Beaver Creek | | .5 |
| 19 | S-101 | 24VL169 | BLM | North Fork Little Beaver Creek | | 5 |
| 65 | S-25 | 24VL170 | BLM | North Fork Little Beaver Creek | | .25 |
| 65 | S-88 | 24VL171 | BLM | North Fork Little Beaver Creek | | 2 |
| 22 | S-90 | 24VL172 | BLM | North Fork Little Beaver Creek | | .25 |
| 22 | S-35 | 24VL173 | BLM | North Fork Little Beaver Creek | | .5 |
| 22 | S-26 | 24VL174 | BLM | North Fork Little Beaver Creek | | 1 |
| 22 | S-91 | 24VL175 | BLM | North Fork Little Beaver Creek | | .5 |
| 22 | S-326 | 24VL176 | BLM | North Fork Little Beaver Creek | | .25 |
| 23 | S-106 | 24VL177 | BLM | North Fork Little Beaver Creek | | .5 |
| 23 | S-151 | 24VL178 | BLM | North Fork Little Beaver Creek | | 20 |
| 24 | S-152 | 24VL179 | BLM | North Fork Little Beaver Creek | | 1 |
| 24 | S-168 | 24VL180 | BLM | North Fork Little Beaver Creek | | small |
| 25 | S-115 | 24VL181 | BLM | North Fork Little Beaver Creek | | 1 |
| 25 | S-114 | 24VL182 | BLM | North Fork Little Beaver Creek | | 1 |
| 25 | S-113 | 24VL183 | BLM | North Fork Little Beaver Creek | | 2 |
| 17 | S-103 | 24VL184 | BLM | North Fork Little Beaver Creek | | .5 |
| 71 | S-104 | 24VL185 | BLM | North Fork Little Beaver Creek | | .5 |
| 71 | S-111 | 24VL186 | BLM | North Fork Little Beaver Creek | | 1 |
| 62 | S-105 | 24VL187 | BLM | North Fork Little Beaver Creek | | 2 |
| 62 | S-37 | 24VL188 | BLM | North Fork Little Beaver Creek | | small |
| 62 | S-112 | 24VL189 | BLM | North Fork Little Beaver Creek | | small |
| 62 | S-92 | 24VL190 | BLM | North Fork Little Beaver Creek | | 2 |
| 63 | S-119 | 24VL191 | BLM | North Fork Little Beaver Creek | | small |
| 63 | S-122 | 24VL192 | BLM | North Fork Little Beaver Creek | | small |
| 63 | S-107 | 24VL193 | BLM | North Fork Little Beaver Creek | | 2 |
| 63 | S-121 | 24VL194 | BLM | North Fork Little Beaver Creek | | .25 |
| 63 | S-138 | 24VL195 | BLM | North Fork Little Beaver Creek | | 1 |
| 63 | S-36 | 24VL392 | BLM | North Fork Little Beaver Creek | | .25 |
| 64 | S-148 | 24VL196 | BLM | North Fork Little Beaver Creek | | small |
| 64 | S-94 | 24VL197 | BLM | North Fork Little Beaver Creek | | 2 |
| 64 | S-124 | 24VL198 | BLM | North Fork Little Beaver Creek | | small |
| 61 | S-120 | 24VL199 | BLM | North Fork Little Beaver Creek | | small |
| 61 | S-117 | 24VL200 | BLM | North Fork Little Beaver Creek | | .25 |
| 61 | S-93 | 24VL201 | BLM | North Fork Little Beaver Creek | | 4 |
| 61 | S-125 | 24VL202 | BLM | North Fork Little Beaver Creek | | .25 |
| 60 | S-118 | 24VL203 | BLM | North Fork Little Beaver Creek | | .25 |
| 60 | S-100 | 24VL204 | BLM | North Fork Little Beaver Creek | | 1 |
| 59 | S-140 | 24VL205 | BLM | North Fork Little Beaver Creek | | 3 |
| 59 | S-97 | 24VL206 | BLM | North Fork Little Beaver Creek | | 3 |

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| 58 | S-27 | 24VL207 | BLM | North Fork Little Beaver Creek | | small |
| 73 | S-128 | 24VL208 | BLM | North Fork Little Beaver Creek | | small |
| 73 | S-172 | 24VL209 | BLM | North Fork Little Beaver Creek | | small |
| 73 | S95 | 24VL210 | BLM | North Fork Little Beaver Creek | | 1 |
| 73 | S-96 | 24VL211 | BLM | North Fork Little Beaver Creek | | 6 |
| 27 | S-139 | 24VL212 | BLM | North Fork Little Beaver Creek | | 2 |
| 27 | S-150 | 24VL395 | BLM | North Fork Little Beaver Creek | | 30 |
| 74 | S-149 | 24VL213 | BLM | North Fork Little Beaver Creek | | 2 |
| 97 | S-127 | 24VL214 | BLM | North Fork Little Beaver Creek | | small |
| 97 | S-126 | 24VL215 | BLM | North Fork Little Beaver Creek | | small |
| 97 | S-193 | 24VL216 | BLM | North Fork Little Beaver Creek | | small |
| 26 | S-179 | 24VL217 | BLM | North Fork Little Beaver Creek | | 1 |
| 26 | S-131 | 24VL218 | BLM | North Fork Little Beaver Creek | | small |
| 26 | S-180 | 24VL219 | BLM | North Fork Little Beaver Creek | | 1 |
| 26 | S-181 | 24VL220 | BLM | North Fork Little Beaver Creek | | 2 |
| 26 | S-188 | 24VL221 | BLM | North Fork Little Beaver Creek | | .25 |
| 26 | S-189 | 24VL222 | BLM | North Fork Little Beaver Creek | | small |
| 100 | S-169 | 24VL223 | BLM | North Fork Little Beaver Creek | | small |
| 15 | S-158 | 24VL224 | BLM | North Fork Little Beaver Creek | | 3 |
| 77 | S-170 | 24VL225 | BLM | North Fork Little Beaver Creek | | .5 |
| 77 | S-171 | 24VL226 | BLM | North Fork Little Beaver Creek | | small |
| 28 | S-182 | 24VL227 | BLM | North Fork Little Beaver Creek | | 1 |
| 29 | S-166 | 24VL228 | BLM | North Fork Little Beaver Creek | | small |
| 29 | | 24VL419 | BLM | North Fork Little Beaver Creek | | small |
| 30 | S-143 | 24VL229 | BLM | North Fork Little Beaver Creek | | 1 |
| 30 | S-190 | 24VL230 | BLM | North Fork Little Beaver Creek | | 1 |
| 30 | S-144 | 24VL231 | BLM | North Fork Little Beaver Creek | | small |
| 30 | S-191 | 24VL232 | BLM | North Fork Little Beaver Creek | | 1 |
| 31 | S-165 | 24VL233 | BLM | North Fork Little Beaver Creek | | 1 |
| 31 | S-132 | 24VL234 | BLM | North Fork Little Beaver Creek | | small |
| 31 | S-164 | 24VL396 | BLM | North Fork Little Beaver Creek | | .25 |
| 32 | S-167 | 24VL235 | BLM | North Fork Little Beaver Creek | | 10 |
| 32 | S-133 | 24VL236 | BLM | North Fork Little Beaver Creek | | 1 |
| 33 | S-184 | 24VL237 | BLM | North Fork Little Beaver Creek | | 2 |
| 34 | S-186 | 24VL238 | BLM | North Fork Little Beaver Creek | | 40 |
| 34 | S-218 | 24VL239 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-146 | 24VL240 | BLM | North Fork Little Beaver Creek | | 2 |
| School Lease "C" | S-185 | 24VL241 | BLM | North Fork Little Beaver Creek | | 15 |
| School Lease "C" | S-134 | 24VL242 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-228 | 24VL243 | BLM | North Fork Little Beaver Creek | | .5 |
| School Lease "C" | S-147 | 24VL244 | BLM | North Fork Little Beaver Creek | | small |

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| School Lease "C" | S-145 | 24VL245 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-196 | 24VL246 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-350 | 24VL247 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-197 | 24VL248 | BLM | North Fork Little Beaver Creek | | 5 |
| School Lease "C" | S-183 | 24VL249 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-195 | 24VL250 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-187 | 24VL251 | BLM | North Fork Little Beaver Creek | | small |
| School Lease "C" | S-220 | 24VL252 | BLM | North Fork Little Beaver Creek | | small |
| 35 | S-194 | 24VL253 | BLM | North Fork Little Beaver Creek | | small |
| 37 | S-219 | 24VL254 | BLM | North Fork Little Beaver Creek | | 2 |
| 37 | S-136 | 24VL255 | BLM | North Fork Little Beaver Creek | | .5 |
| 37 | S-200 | 24VL256 | BLM | North Fork Little Beaver Creek | | small |
| 37 | S-199 | 24VL257 | BLM | North Fork Little Beaver Creek | | small |
| 38 | S-135 | 24VL258 | BLM | North Fork Little Beaver Creek | | 10 |
| 39 | S-264 | 24VL259 | BLM | North Fork Little Beaver Creek | | small |
| 39 | S-201 | 24VL260 | BLM | North Fork Little Beaver Creek | | small |
| 40 | S0231 | 24VL261 | BLM | North Fork Little Beaver Creek | | 1 |
| 40 | S-230 | 24VL262 | BLM | North Fork Little Beaver Creek | | .5 |
| 40 | S-229 | 24VL263 | BLM | North Fork Little Beaver Creek | | .5 |
| 40 | S-202 | 24VL264 | BLM | North Fork Little Beaver Creek | | 2 |
| 42 | S-239 | 24VL265 | BLM | North Fork Little Beaver Creek | | 2 |
| 42 | S-262 | 24VL266 | BLM | North Fork Little Beaver Creek | | small |
| 42 | S-263 | 24VL267 | BLM | North Fork Little Beaver Creek | | small |
| 42 | S-226 | 24VL268 | BLM | North Fork Little Beaver Creek | | small |
| 42 | S-227 | 24VL269 | BLM | North Fork Little Beaver Creek | | .25 |
| 43 | S-300 | 24VL270 | BLM | North Fork Little Beaver Creek | | small |
| 43 | S-299 | 24VL271 | BLM | North Fork Little Beaver Creek | | small |
| 43 | S-298 | 24VL272 | BLM | North Fork Little Beaver Creek | | small |
| 43 | S-261 | 24VL273 | BLM | North Fork Little Beaver Creek | | small |
| 43 | S-234 | 24VL274 | BLM | North Fork Little Beaver Creek | | .5 |
| 44 | S-267 | 24VL275 | BLM | North Fork Little Beaver Creek | | small |
| 46 | S-242 | 24VL276 | BLM | North Fork Little Beaver Creek | | small |
| 46 | S-109 | 24VL277 | BLM | North Fork Little Beaver Creek | | .5 |
| 46 | S-207 | 24VL278 | BLM | North Fork Little Beaver Creek | | 1.5 |
| 46 | S-236 | 24VL279 | BLM | North Fork Little Beaver Creek | | 1 |
| 46 | S-235 | 24VL280 | BLM | North Fork Little Beaver Creek | | .5 |
| 47 | S-204 | 24VL281 | BLM | North Fork Little Beaver Creek | | 4 |
| 47 | S-233 | 24VL282 | BLM | North Fork Little Beaver Creek | | 15 |
| 47 | S-123 | 24VL283 | BLM | North Fork Little Beaver Creek | | .5 |
| 47 | S-260 | 24VL284 | BLM | North Fork Little Beaver Creek | | small |
| 47 | S-225 | 24VL285 | BLM | North Fork Little Beaver Creek | | 10 |

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| 47 | S-224 | 24VL286 | BLM | North Fork Little Beaver Creek | | .5 |
| 47 | S-223 | 24VL287 | BLM | North Fork Little Beaver Creek | | small |
| 47 | S-208 | 24VL288 | BLM | North Fork Little Beaver Creek | | small |
| 47 | S-247 | 24VL289 | BLM | North Fork Little Beaver Creek | | small |
| 47 | S-222 | 24VL290 | BLM | North Fork Little Beaver Creek | | small |
| 48 | S-258 | 24VL291 | BLM | North Fork Little Beaver Creek | | small |
| 48 | S-265 | 24VL292 | BLM | North Fork Little Beaver Creek | | small |
| 48 | S-203 | 24VL293 | BLM | North Fork Little Beaver Creek | | small |
| 48 | S-238 | 24VL294 | BLM | North Fork Little Beaver Creek | | small |
| 48 | S-232 | 24VL295 | BLM | North Fork Little Beaver Creek | | 25 |
| 49 | S-206 | 24VL296 | BLM | North Fork Little Beaver Creek | | 1.25 |
| 49 | S-205 | 24VL297 | BLM | North Fork Little Beaver Creek | | small |
| 50 | S-269 | 24VL298 | BLM | North Fork Little Beaver Creek | | 1 |
| 50 | S-268 | 24VL299 | BLM | North Fork Little Beaver Creek | | .5 |
| 50 | S-237 | 24VL300 | BLM | North Fork Little Beaver Creek | | 1 |
| 50 | S-210 | 24VL301 | BLM | North Fork Little Beaver Creek | | 2 |
| 50 | S-301 | 24VL302 | BLM | North Fork Little Beaver Creek | | small |
| 50 | S-302 | 24VL399 | BLM | North Fork Little Beaver Creek | | 10 |
| 56 | S-241 | 24VL303 | BLM | North Fork Little Beaver Creek | | 2 |
| 56 | S-244 | 24VL304 | BLM | North Fork Little Beaver Creek | | 10 |
| 45 | S-245 | 24VL305 | BLM | North Fork Little Beaver Creek | | .25 |
| 45 | S-272 | 24VL306 | BLM | North Fork Little Beaver Creek | | .5 |
| 45 | S-266 | 24VL307 | BLM | North Fork Little Beaver Creek | | small |
| 45 | S-259 | 24VL308 | BLM | North Fork Little Beaver Creek | | small |
| 45 | S-209 | 24VL309 | BLM | North Fork Little Beaver Creek | | small |
| 45 | S-221 | 24VL310 | BLM | North Fork Little Beaver Creek | | small |
| 57 | S-305 | 24VL311 | BLM | North Fork Little Beaver Creek | | small |
| 51 | S-271 | 24VL312 | BLM | North Fork Little Beaver Creek | | .5 |
| 51 | S-310 | 24VL313 | BLM | North Fork Little Beaver Creek | | small |
| 51 | S-304 | 24VL314 | BLM | North Fork Little Beaver Creek | | small |
| 52 | S-306 | 24VL315 | BLM | North Fork Little Beaver Creek | | small |
| 52 | S-303 | 24VL316 | BLM | North Fork Little Beaver Creek | | small |
| 52 | S-270 | 24VL317 | BLM | North Fork Little Beaver Creek | | small |
| 52 | S-243 | 24VL318 | BLM | North Fork Little Beaver Creek | | 2 |
| 54 | S-249 | 24VL319 | BLM | North Fork Little Beaver Creek | | 10 |
| 54 | S-307 | 24VL320 | BLM | North Fork Little Beaver Creek | | .25 |
| 78 | S-240 | 24VL321 | BLM | North Fork Little Beaver Creek | | 1 |
| 78 | S-290 | 24VL322 | BLM | North Fork Little Beaver Creek | | .25 |
| 78 | S-289 | 24VL323 | BLM | North Fork Little Beaver Creek | | 1 |
| 78 | S-248 | 24VL398 | BLM | North Fork Little Beaver Creek | | small |
| 79 | S-275 | 24VL324 | BLM | North Fork Little Beaver Creek | | .5 |

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| 79 | S-288 | 24VL325 | BLM | North Fork Little Beaver Creek | | small |
| 79 | S-274 | 24VL326 | BLM | North Fork Little Beaver Creek | | 5 |
| 79 | S-246 | 24VL327 | BLM | North Fork Little Beaver Creek | | 2 |
| 55 | S-308 | 24VL328 | BLM | North Fork Little Beaver Creek | | small |
| 55 | S-327 | 24VL329 | BLM | North Fork Little Beaver Creek | | small |
| 55 | S-212 | 24VL330 | BLM | North Fork Little Beaver Creek | | .25 |
| 80 | S-211 | 24VL331 | BLM | North Fork Little Beaver Creek | | .5 |
| 80 | S-309 | 24VL332 | BLM | North Fork Little Beaver Creek | | small |
| 80 | S-311 | 24VL333 | BLM | North Fork Little Beaver Creek | | small |
| 80 | S-314 | 24VL334 | BLM | North Fork Little Beaver Creek | | .25 |
| 81 | S-313 | 24VL335 | BLM | North Fork Little Beaver Creek | | 80 |
| 81 | S-315 | 24VL336 | BLM | North Fork Little Beaver Creek | | small |
| 81 | S-312 | 24VL337 | BLM | North Fork Little Beaver Creek | | small |
| 82 | S-213 | 24VL338 | BLM | Larb Creek | | 25 |
| 82 | S-251 | 24VL339 | BLM | Larb Creek | | small |
| 82 | S-273 | 24VL340 | BLM | Larb Creek | | .5 |
| 82 | S-250 | 24VL341 | BLM | Larb Creek | | .5 |
| 83 | S-316 | 24VL342 | BLM | Larb Creek | | small |
| 83 | S-317 | 24VL343 | BLM | Larb Creek | | small |
| 84 | S-320 | 24VL401 | BLM | Larb Creek | | small |
| 98 | S-318 | 24VL344 | BLM | Lone Tree Creek | | small |
| School Lease "D" | S-276 | 24VL345 | BLM | Lone Tree Creek | | small |
| School Lease "D | S-277 | 24VL346 | BLM | Larb Creek | | 5 |
| School Lease "D" | S-291 | 24VL347 | BLM | Lone Tree Creek | | small |
| School Lease "D" | S-294 | 24VL348 | BLM | Lone Tree Creek | | 10 |
| School Lease "D" | S-252 | 24VL349 | BLM | Lone Tree Creek | | 2 |
| School Lease "D" | S-253 | 24VL350 | BLM | Larb Creek | | small |
| School Lease "D" | S-280 | 24VL351 | BLM | Lone Tree Creek | | 3 |
| School Lease "D" | S-279 | 24VL352 | BLM | Larb Creek | | 80 |
| 85 | S-321 | 24VL353 | BLM | Larb Creek | | .25 |
| 85 | S-322 | 24VL363 | BLM | Larb Creek | | 5 |
| 85 | S-319 | 24VL400 | BLM | Larb Creek | | 5 |
| 86 | S-214 | 24VL354 | BLM | Larb Creek | | 20 |
| 86 | S-281 | 24VL355 | BLM | Larb Creek | | 5 |
| 86 | S-215 | 24VL356 | BLM | Larb Creek | | 5 |
| 86 | S-292 | 24VL357 | BLM | Larb Creek | | 3 |
| 87 | S-297 | 24VL358 | BLM | Larb Creek | | small |
| 88 | S-254 | 24VL359 | BLM | Larb Creek | | .25 |
| 88 | S-255 | 24VL360 | BLM | Larb Creek | | small |
| 88 | S-323 | 24VL361 | BLM | Larb Creek | | small |
| 88 | S-217 | 24VL397 | BLM | North Fork Little Beaver Creek | | 2 |

| Claim No. | Field Site No. | Site Number | Map Reference | Drainage/Physiographic Unit | Elevation (a.m.s.l.) | Estimated Site Area (Acres) |
|---|---|---|---|---|---|---|
| 89 | S-293 | 24VL362 | BLM | Larb Creek | | 4 |
| 90 | S-256 | 24VL364 | BLM | Larb Creek | | 4 |
| 90 | S-257 | 24VL365 | BLM | Larb Creek | | small |
| 91 | S-285 | 24VL366 | BLM | Grant Coulee | | 2 |
| 92 | S-216 | 24VL367 | BLM | Larb Creek | | small |
| 92 | S-324 | 24VL368 | BLM | Larb Creek | | small |
| 93 | S-325 | 24VL369 | BLM | Larb Creek | | small |
| 93 | S-282 | 24VL370 | BLM | Larb Creek | | small |
| 93 | S-284 | 24VL371 | BLM | Grant Coulee | | 5 |
| 138 | S-72 | 24VL372 | BLM | South Fork Brazil Creek | | small |
| 139 | S-157 | 24VL373 | BLM | North Fork Little Beaver Creek | | small |
| 139 | S-175 | 24VL374 | BLM | North Fork Little Beaver Creek | | .25 |
| 139 | S-129 | 24VL375 | BLM | North Fork Little Beaver Creek | | small |
| 141 | S-156 | 24VL376 | BLM | North Fork Little Beaver Creek | | .25 |
| 141 | S-159 | 24VL377 | BLM | North Fork Little Beaver Creek | | .25 |
| 143 | S-142 | 24VL378 | BLM | North Fork Little Beaver Creek | | 1 |
| 143 | S-177 | 24VL379 | BLM | North Fork Little Beaver Creek | | small |
| 143 | S-154 | 24VL380 | BLM | North Fork Little Beaver Creek | | 5 |
| 143 | S-174 | 24VL381 | BLM | North Fork Little Beaver Creek | | .25 |
| 144 | S-178 | 24VL382 | BLM | South Fork Brazil Creek | | 30 |
| 144 | S-130 | 24VL386 | BLM | South Fork Brazil Creek | | 4 |
| 145 | S-162 | 24VL383 | BLM | North Fork Little Beaver Creek | | small |
| 145 | S-161 | 24VL384 | BLM | North Fork Little Beaver Creek | | .25 |
| 145 | S-141 | 24VL385 | BLM | North Fork Little Beaver Creek | | small |
| 146 | S-163 | 24VL387 | BLM | South Fork Brazil Creek | | 8 |
| 147 | S-176 | 24VL388 | BLM | North Fork Little Beaver Creek | | small |
| 147 | S-155 | 24VL389 | BLM | North Fork Little Beaver Creek | | 1 |
| 147 | S-192 | 24VL390 | BLM | North Fork Little Beaver Creek | | .25 |
| 147 | S-160 | 24VL391 | BLM | North Fork Little Beaver Creek | | 4 |

# Appendix 2. Archaeological and Historical Sites in the Brazil and Little Beaver Creeks Drainage Areas: Site Type, Physical Evidence, and Cultural Classification.[1,2]

| Claim No. | Site No. | Type of Site | FB | H | SC | C | SP | DL | G | RC | SD | HR | PP | B | PE | S | RF | C | QD | EF | H | SE | C | BD | HD | CP | CP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | 24VL101 | Rock Cluster | | 1 | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 69 | 24VL102 | Cairn | X | | | 9 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 69 | 24VL103 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 69 | 24VL104 | Bison Kill | X | | | | X | X | | | | | | | | | | | X | | | | | X | | ? | P |
| 69 | 24VL105 | Cairn | | | | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | 24VL106 | Habitation | | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 69 | 24VL107 | Habitation/Cairn | | | | M | | | | | | | | | | | | | X | | | | | | | ? | P |
| BLM "A" | 24VL108 | Historic Homestead | | | | | | | | | | X | | | | | | | | | | | | | X | R | H |
| BLM "A" | 24VL109 | Cairn | | | | 1 | | | | | | | | | | | | | | | | | | | | ? | P |
| BLM "A" | 24VL110 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| BLM "A" | 24VL111 | Habitation-Stone Circle/Cairn | | | 1 | M | | | | 1 | | | | | | | | | X | 3 | | | | | | ? | P |
| BLM "A" | 24VL413 | Habitation | | | | | | | | | | | | 1 | | | | | | | | | | | | ? | P |
| 68 | 24VL112 | Habitation | | | | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| 68 | 24VL113 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 68 | 24VL114 | Habitation-Stone Circle | | | 1 | 4 | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 67 | 24VL115 | Drive Line | | | | | | X | | | | | | 1 | | | | | | X | | | | | | ? | P |
| 70 | 24VL116 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 70 | 24VL117 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| BLM "B" | 24VL118 | Historic Homestead | | | | | | | | | | X | | | | | | | | | | | | X | | R | H |
| BLM "B" | 24VL119 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| BLM "B" | 24VL120 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| BLM "C" | 24VL121 | Habitation | X | | | | | | | | | | | | | | | | X | 2 | | | | | | ? | P |
| BLM "C" | 24VL122 | Habitation | | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| BLM "C" | 24VL123 | Habitation/ Drive Line | | 1 | | M | | X | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "A" | 24VL124 | Habitation/ Cairn | | | | 2 | | | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "A" | 24VL125 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "A" | 24VL126 | Rock Cluster | | 1 | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| School Lease "A" | 24VL127 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| School Lease "A" | 24VL128 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "A" | 24VL129 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "A" | 24VL130 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| School Lease "A" | 24VL131 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| School Lease "A" | 24VL132 | Habitation/Cairn | X | | | M | | | | | | | | | | | | | X | 1 | | | | | X | ?/R | P/H |
| School Lease "A" | 24VL133 | Habitation | X | 1 | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "A" | 24VL134 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 1 | 24VL135 | Habitation | X | | | | | | | | | | 1 | | | 1 | | | X | X | | | | | | PL | M |
| 1 | 24VL136 | Habitation | | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 1 | 24VL137 | Habitation | X | | | | 6 | | | | | | | | | | | | X | | | | | | | ? | P |
| 1 | 24VL138 | Habitation | | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 1 | 24VL139 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 1 | 24VL140 | Habitation-Stone Circle | X | | 3 | | | | | | | | | | | | | | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 24VL141 | Habitation/Rock Cluster/Cairn | X | | 1 | 2 | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 3 | 24VL142 | Habitation-Stone Circle | | | 4 | | | | | | | | | 1 | | | | | X | | | | | | | ? | P |
| 3 | 24VL143 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 3 | 24VL144 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 3 | 24VL145 | Habitation-Stone Circle | | M | 5 | | | | | | | | | | | | | | X | X | | | | | | ? | P |
| 3 | 24VL146 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 3 | 24VL147 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 5 | 24VL148 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 5 | 24VL149 | Habitation-Stone Circle | X | | 1 | | 2 | | | | | | | | | | | | X | | | | | | | ? | P |
| 6 | 24VL150 | Habitation-Stone Circle/Rock Cluster | | | 3 | 1 | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 9 | 24VL151 | Historic Homestead | | | | | | | | | | X | | | | | | | | | | | | | X | R | H |
| 10 | 24VL152 | Drive Line | | | 23 | | | X | | | | | | | | 1 | | | X | | | | | | | ? | P |
| 11 | 24VL153 | Habitation-Stone Circle | | | 2 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 11 | 24VL154 | Habitation | | 1 | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 12 | 24VL155 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 12 | 24VL156 | Habitation | | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 12 | 24VL157 | Habitation-Stone Circle | | | 3 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 12 | 24VL158 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 12 | 24VL159 | Habitation | | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 118 | 24VL160 | Rock Cluster | X | | | | | | | 15 | | | | | | | | | | | | | | | | ? | P |
| Plant Site | 24VL161 | Habitation-Stone Circle | X | | 23 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| Plant Site | 24VL162 | Habitation-Stone Circle | | | 15 | | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "B" | 24VL163 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| School Lease "B" | 24VL393 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 21 | 24VL164 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 21 | 24VL165 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 21 | 24VL166 | Habitation-Stone Circle | X | | 3 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 18 | 24VL394 | Habitation | X | | | | | | | | X | | | | | | | | X | 21 | | | | | X | ? | P |
| 19 | 24VL167 | Rock Cluster | X | | | | | | | 2 | | | | | | | | | X | | | | | | | ? | P |
| 19 | 24VL168 | Habitation | X | | | | | | | | | | | | | | | | | X | | | | | | ? | P |
| 19 | 24VL169 | Rock Cluster | X | | | | | X | | 2 | | | | | | | | | X | X | | | | | | ? | P |
| 65 | 24VL170 | Rock Cluster | X | | 1 | | | | | M | | | | | | | | | X | 1 | | | | | | ? | P |
| 65 | 24VL171 | Habitation-Stone Circle | X | 3 | 2 | M | | | | | | | 1 | | | | | | X | 1 | | | | | | OW | L |
| 22 | 24VL172 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 22 | 24VL173 | Habitation-Stone Circle | X | 1 | 6 | | | | | | | | | | | | | | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | FB | H | SC | C | SP | DL | G | RC | SD | HR | PP | B | PE | S | RF | C | QD | EF | H | SE | C | BD | HD | CP | CP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22 | 24VL174 | Habitation-Stone Circle | X | X | M | M | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 22 | 24VL175 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 22 | 24VL176 | Rock Alignment | | | | | | 1 | | | | | | | | | | | | | | | | | | ? | P |
| 23 | 24VL177 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 23 | 24VL178 | Habitation-Stone Circle | X | | 10 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 24 | 24VL179 | Habitation | X | | | | | | | | | | | | | | 2 | | X | 3 | | | | | | ? | P |
| 24 | 24VL180 | Rock Cluster | X | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 25 | 24VL181 | Cairn | X | | | 1 | | | | | | | | | | | | | | 1 | | | | | | ? | P. |
| 25 | 24VL182 | Habitation | | | | | | | | M | | | | | | | | | | | | | | X | | ? | P |
| 25 | 24VL183 | Habitation | X | M | | | | | | | | | | | | | | | | X | | | | | | ? | P |
| 17 | 24VL184 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| 71 | 24VL185 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| 71 | 24VL186 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | 2 | | | | | | ? | P |
| 62 | 24VL187 | Habitation-Stone Circle | X | M | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 62 | 24VL188 | Cairn | | | | 7 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 62 | 24VL189 | Rock Cluster | X | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 62 | 24VL190 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 63 | 24VL191 | Habitation | X | X | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 63 | 24VL192 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 63 | 24VL193 | Habitation-Stone Circle | X | | 4 | | | | | | | | | 1 | | 1 | 2 | | X | 26 | | | 8 | X | | ? | P |
| 63 | 24VL194 | Rock Cluster | X | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 63 | 24VL195 | Habitation-Stone Circle | X | | 5 | M | | | | | | | | | | | | | X | | | | | | | ? | P |
| 63 | 24VL392 | Habitation/Cairn | X | | | 2 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 64 | 24VL196 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 64 | 24VL197 | Habitation-Stone Circle | X | | 6 | | M | | | | | | | | | | | | X | | | | | | | ? | P |
| 64 | 24VL198 | Rock Cluster | X | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 61 | 24VL199 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 61 | 24VL200 | Surface Depression | X | | | | | | | | M | | | | | | | | | | | | | | | ? | P |
| 61 | 24VL201 | Habitation-Stone Circle | X | | 10 | | | | | | | | | | | | 1 | | X | | | | | X | | ? | P |
| 61 | 24VL202 | Habitation | X | | | | | | | | | | | | | 1 | | | X | X | | | | X | | ? | P |
| 60 | 24VL203 | Habitation-Stone Circle | X | | 1 | 3 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 60 | 24VL204 | Habitation | X | | | | | | | | | | | | | | | | X | X | | | | | | ? | P |
| 59 | 24VL205 | Habitation-Stone Circle | X | X | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 59 | 24VL206 | Habitation-Stone Circle | X | | 12 | M | M | X | | | | | | | | | | | X | | | | | | | ? | P |
| 58 | 24VL207 | Rock Cluster | X | | | 2 | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 73 | 24VL208 | Habitation-Stone Circle | X | | 11 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 73 | 24VL209 | Habitation | X | 2 | | | | | | | | | | | | | | | X | X | | | | | | ? | P |
| 73 | 24VL210 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 73 | 24VL211 | Habitation-Stone Circle | X | | M | M | | | | | | | | | | | | 1 | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 24VL212 | Habitation-Stone Circle | | 13 | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 27 | 24VL395 | Habitation-Stone Circle | X | M | 75 | | | | | | | | | | | | | | X | X | | | | X | | ? | P |
| 74 | 24VL213 | Habitation-Stone Circle/Rock Cluster | | | 2 | | | | | 2 | | | | | | | | | X | | | | | | | ? | P |
| 97 | 24VL214 | Habitation-Stone Circle | X | | 3 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 97 | 24VL215 | Rock Cluster | X | | | | | | | 2 | | | | | | | | | X | | | | | X | | ? | P |
| 97 | 24VL216 | Habitation | X | | | | | | | | | | | | | | 1 | | X | | | | | | | ? | P |
| 26 | 24VL217 | Habitation | X | 3 | | | | | | | | | | | | | | | X | X | | | | X | | ? | P |
| 26 | 24VL218 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 26 | 24VL219 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 26 | 24VL220 | Habitation | X | X | | | | | | | | | | | | 2 | | | X | 2 | | | | X | | ? | P |
| 26 | 24VL221 | Habitation-Stone Circle | | | 4 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 26 | 24VL222 | Drive Line | X | | | | | X | | | | | | | | | | | X | | | | | | | ? | P |
| 100 | 24VL223 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 15 | 24VL224 | Habitation-Stone Circle | X | | 6 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 77 | 24VL225 | Habitation | X | | | | | | | | | | | | | | 1 | | X | | | | | X | | ? | P |
| 77 | 24VL226 | Rock Cluster | X | | | | | | | 1 | | | | | | | | | X99 | | | | | | | ? | P |
| 28 | 24VL227 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| 29 | 24VL228 | Cairn | X | | 1 | | | | | | | | 1 | | | | | | X | 1 | | | | | | OW | L |
| 29 | 24VL419 | Habitation | | | | | | | | | | | 1 | | | | | | | 1 | | | | | | ? | P |
| 30 | 24VL229 | Habitation | X | 1 | | | | | | | | | | | | | | 1 | X | | | | | | | ? | P |
| 30 | 24VL230 | Habitation-Stone Circle/Drive Line | | | 1 | | | 2 | | | | | | | | | | | | | | | | | | ? | P |
| 30 | 24VL231 | Cairn | | | | 2 | | | | | | | | | | | | | | | | | | | | ? | P |
| 30 | 24VL232 | Habitation | X | | | | | | | | | | | | | | | | X15 | | | | | X | | ? | P |
| 31 | 24VL233 | Habitation-Stone Circle | X | | 8 | | 2 | | | | | | | | | | | | X | | | | | | | ? | P |
| 31 | 24VL234 | Habitation-Stone Circle | | | 3 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 31 | 24VL396 | Habitation | X | | | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 32 | 24VL235 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 32 | 24VL236 | Habitation-Stone Circle | X | | 9 | 2 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 33 | 24VL237 | Habitation-Stone Circle | | 1 | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 34 | 24VL238 | Habitation-Stone Circle/Drive Line | | | 32 | | | 3 | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 34 | 24VL239 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "C" | 24VL240 | Habitation/Cairn | | 2 | | 1 | | | | | | | | 1 | | | | | X | 4 | | | | | | ? | P |
| School Lease "C" | 24VL241 | Habitation-Stone Circle | | | 15 | | | 2 | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "C" | 24VL242 | Habitation-Stone Circle | X | | 2 | | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "C" | 24VL243 | Habitation | X | | | | | | | | | | | | | 1 | | | X | X | | | | X | | ? | P |
| School Lease "C" | 24VL244 | Cairn | | | | 5 | | | | | | | | | | | | | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| School Lease "C" | 24VL245 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "C" | 24VL246 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | X | | ? | P |
| School Lease "C" | 24VL247 | Habitation | | 1 | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "C" | 24VL248 | Habitation | X | | | | | | | | | | | | | | | | X21 | | | | | | | ? | P |
| School Lease "C" | 24VL249 | Habitation | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| School Lease "C" | 24VL250 | Habitation | X | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| School Lease "C" | 24VL251 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "C" | 24VL252 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 35 | 24VL253 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 37 | 24VL254 | Habitation-Stone Circle/Drive Line | X | | 2 | | | 1 | | | | | | | 9 | 6 | 12 | 3 | X79 | | | | | X | | ? | P |
| 37 | 24VL255 | Habitation-Stone Circle | X | X | 5 | 2 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 37 | 24VL256 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 37 | 24VL257 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 38 | 24VL258 | Habitation/Drive Line | X | | 5 | | | 5 | | | | | | | | | | 1 | X | 3 | | | | | | ? | P |
| 39 | 24VL259 | Historic | | | | | | | | | | | | | | | | | | | | | | | X | R | H |
| 39 | 24VL260 | Habitation | X | 1 | | | | | | | | | | | | | | | | | | | | | | ? | P |
| 40 | 24VL261 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 40 | 24VL262 | Habitation-Stone Circle | X | | 2 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 40 | 24VL263 | Habitation-Stone Circle | | | 2 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 40 | 24VL264 | Habitation | X | 1 | 3 | | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 42 | 24VL265 | Habitation/Cairn | X | | | M | | | | | | | | | | | | 1 | X12 | | | 1 | | | | ? | P |
| 42 | 24VL266 | Habitation-Stone Circle | X | | 2 | | | | | | | | | 2 | 1 | 2 | 3 | | X | | | | | | | ? | P |
| 42 | 24VL267 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 42 | 24VL268 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 42 | 24VL269 | Habitation-Stone Circle | | | 2 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 43 | 24VL270 | Habitation-Stone Circle | X | | 2 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 43 | 24VL271 | Rock Cluster | X | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 43 | 24VL272 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 43 | 24VL273 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 43 | 24VL274 | Habitation-Stone Circle | | | 4 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 44 | 24VL275 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 46 | 24VL276 | Habitation | X | | | | | | | | | | | | | | | | X | 2 | | | | | | ? | P |
| 46 | 24VL277 | Habitation | X | 1 | | | | | | | | | | | | | | | | | | | | | | ? | P |
| 46 | 24VL278 | Habitation | X | 2 | | | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 46 | 24VL279 | Habitation | X | | | | | | | | | | | | | | | | X | 6 | | | | X | | ? | P |
| 46 | 24VL280 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 | 24VL281 | Habitation/Cairn | X | | | M | | | | | | | | | | | | | X | | | | | | | ? | P |
| 47 | 24VL282 | Habitation-Stone Circle | X | M | 17 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 47 | 24VL283 | Habitation-Stone Circle | X | | 6 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 47 | 24VL284 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 47 | 24VL285 | Habitation | X | | | | | | | | | | | | | | | | X | X | | | | | | ? | P |
| 47 | 24VL286 | Habitation-Stone Circle | | | 3 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 47 | 24VL287 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 47 | 24VL288 | Habitation-Stone Circle | | 1 | 1 | 2 | | | | | | | | | | | | | | | | | | | | ? | P |
| 47 | 24VL289 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 47 | 24VL290 | Rock Cluster | X | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 48 | 24VL291 | Habitation | | 1 | | | | | | | | | | | | | | | | | | | | | | ? | P |
| 48 | 24VL292 | Habitation | | 1 | | | | | | | | | | | | | | | | | | | | | | ? | P |
| 48 | 24VL293 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 48 | 24VL294 | Habitation/Cairn | | | | 2 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 48 | 24VL295 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 49 | 24VL296 | Habitation | X | 1 | | | | | | | | | | | | | | | X | 2 | | | | | | ? | P |
| 49 | 24VL297 | Habitation/Cairn | X | | | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 50 | 24VL298 | Rock Alignment | | | | | | 1 | | | | | | | | | | | | | | | | | | ? | P |
| 50 | 24VL299 | Rock Alignment | | | | 1 | M | | | | | | | | | | | | | | | | | | | ? | P |
| 50 | 24VL300 | Rock Alignment | | | | M | | 1 | | | | | | | | | | | | | | | | | | ? | P |
| 50 | 24VL301 | Habitation-Stone Circle | X | | 120 | | | | | | | | | 1 | | | | | X | 1 | | | | | | ? | P |
| 50 | 24VL302 | Habitation | X | 1 | | | | | | | | | | | | | | | | | | | | | | ? | P |
| 50 | 24VL399 | Habitation-Stone Circle Rock Alignment | | | 1 | | | 1 | | | | | | | | | | | | | | | | | | ? | P |
| 56 | 24VL303 | Rock Cluster | X | | | 2 | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 56 | 24VL304 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 45 | 24VL305 | Rock Cluster | X | | | | | | | 2 | | | | | | | | | X | | | | | | | ? | P |
| 45 | 24VL306 | Habitation/Cairn | X | | | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 45 | 24VL307 | Habitation | X | | | | | | | | | | | | | | | | X | X | | | | X | | ? | P |
| 45 | 24VL308 | Habitation | X | | | | | | | | | | | | | | | | X | X | | | | X | | ? | P |
| 45 | 24VL309 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 45 | 24VL310 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 57 | 24VL311 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 51 | 24VL312 | Rock Cluster/Cairn | | | | 3 | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 51 | 24VL313 | Rock Cluster | X | | | | | | | 2 | | | | | | | | | X | | | | | | | ? | P |
| 51 | 24VL314 | Habitation-Stone Circle | | | 3 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 52 | 24VL315 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 52 | 24VL316 | Habitation | X | 2 | | | | | | | | | | | | | | | | | | | | X | | ? | P |
| 52 | 24VL317 | Rock Alignment | | | | M | | 1 | | | | | | | | | | | | | | | | | | ? | P |
| 52 | 24VL318 | Rock Alignment | | | | M | | 2 | | | | | | | | | | | X | | | | | | | ? | P |
| 54 | 24VL319 | Rock Alignment | | | | M | | 1 | | | | | | | | | | | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 | 24VL320 | Habitation | X | | | | | | | | | | | | | | | | X | X | | | | | | ? | P |
| 78 | 24VL321 | Habitation-Stone Circle | X | | 21 | | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 78 | 24VL322 | Habitation/Cairn | X | | | 4 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 78 | 24VL323 | Rock Cluster/ Rock Alignment | | | | | | 1 | | 4 | | | | | | | | | | | | | | | | ? | P |
| 78 | 24VL398 | Habitation-Stone Circle | X | 2 | 11 | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 79 | 24VL324 | Rock Cluster/ Cairn | | | | 1 | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 79 | 24VL325 | Habitation | X | | | | | | | | | | | | | | | | | | | | | | | ? | P |
| 79 | 24VL326 | Ringed Cairn | | | 1 | 1 | M | | | | | | | | | | | | X | | | | | | | ? | P |
| 79 | 24VL327 | Rock Cluster/ Cairn | X | | | 1 | | | | 14 | | | | | | | | | X | | | | | | | ? | P |
| 55 | 24VL328 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 55 | 24VL329 | Habitation | X | | | | | | | | | | | | | | 1 | | | | | | | | | ? | P |
| 55 | 24VL330 | Habitation-Stone Circle | X | | 7 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 80 | 24VL331 | Habitation-Stone Circle | | | 2 | | | | | | | | | | | | | | | | | | | X | | ? | P |
| 80 | 24VL332 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 80 | 24VL333 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 80 | 24VL334 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 81 | 24VL335 | Habitation-Stone Circle | | | 2 | M | | | | | | | | | | | | | | | | | | | | ? | P |
| 81 | 24VL336 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 81 | 24VL337 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 82 | 24VL338 | Habitation-Stone Circle | X | M | 33 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 82 | 24VL339 | Habitation | X | 1 | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 82 | 24VL340 | Habitation/Cairn | X | 1 | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 82 | 24VL341 | Habitation | X | | 1 | 2 | | | | | | | | | | | | | X | X | | | | | | ? | P |
| 83 | 24VL342 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 83 | 24VL343 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 84 | 24VL401 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | X | | ? | P |
| 98 | 24VL344 | Habitation-Stone Circle | | | 1 | 4 | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "D" | 24VL345 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| School Lease "D" | 24VL346 | Habitation-Stone Circle | | | 4 | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "D" | 24VL347 | Rock Cluster | X | | | | | | | 2 | | | | | | | 1 | | X | 1 | | | | | | ? | P |
| School Lease "D" | 24VL348 | Habitation | X | | | | | | | | | | | | | | | | X | X | | | | | | ? | P |
| School Lease "D" | 24VL349 | Habitation | X | 2 | | | | | | | | | | | | | | | X | 9 | 1 | | | | X | ?/R | P/H |
| School Lease "D" | 24VL350 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| School Lease "D" | 24VL351 | Habitation-Stone Circle | X | | 16 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| School Lease "D" | 24VL352 | Habitation-Stone Circle | X | M | 50 | M | | 1 | | | | | | 1 | | | 2 | 1 | X | 7 | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 85 | 24VL353 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 85 | 24VL363 | Rock Cluster/Cairn | X | | | 1 | | 4 | | | | | | | | | | | X | | | | | | | ? | P |
| 85 | 24VL400 | Habitation-Stone Circle | | M | 4 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 86 | 24VL354 | Habitation-Stone Circle | X | | 6 | 5 | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 86 | 24VL355 | Habitation-Stone Circle | | | 15 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 86 | 24VL356 | Habitation-Stone Circle | X | | 3 | 5 | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 86 | 24VL357 | Habitation-Stone Circle | X | | 2 | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 87 | 24VL358 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 88 | 24VL359 | Habitation-Stone Circle | | | M | 2 | | | | | | | | | | | | | X | 1 | | | | | | ? | P |
| 88 | 24VL360 | Habitation-Stone Circle | X | | 2 | | | 1 | | | | | | | | | | | X | | | | | | | ? | P |
| 88 | 24VL361 | Rock Cluster/Cairn | | | | 2 | | 1 | | | | | | | | | | | | | | | | | | ? | P |
| 88 | 24VL397 | Rock Alignment | | | | | | 1 | | | | | | | | | | | X | | | | | | | ? | P |
| 89 | 24VL362 | Habitation-Stone Circle | X | | 10 | | 3 | | | | | | | | | | | | X | | | | | | | ? | P |
| 90 | 24VL364 | Habitation-Stone Circle | X | | M | | | | | | | | | | | | | | | | | | | | | ? | P |
| 90 | 24VL365 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 91 | 24VL366 | Habitation-Stone Circle | X | 1 | 5 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 92 | 24VL367 | Habitation-Stone Circle | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | ? | P |
| 92 | 24VL368 | Habitation-Stone Circle | | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 93 | 24VL369 | Trade Point | | | | | | | | | | | 1 | | | | | | | | | | | | X | Pr | A |
| 93 | 24VL370 | Rock Cluster | | | | | | | | 1 | | | | | | | | | | | | | | | | ? | P |
| 93 | 24VL371 | Habitation-Stone Circle | X | | 8 | 4 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 138 | 24VL372 | Rock Cluster | | | | | | | | 1 | | | | | | 1 | | | X | | | | | | | ? | P |
| 139 | 24VL373 | Rock Cluster | | | | | | | | 1 | | | | | | | | | X | | | | | | | ? | P |
| 139 | 24VL374 | Habitation-Stone Circle/Drive Line | X | | 1 | | | 1 | | | | | | | | | | | X | | | | | | | ? | P |
| 139 | 24VL375 | Habitation-Stone Circle | X | | 3 | 1 | | | | | | | | | | | | | | | | | | | | ? | P |
| 141 | 24VL376 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 141 | 24VL377 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 143 | 24VL378 | Habitation-Stone Circle/Cairn | | | 1 | 2 | | | | | | | | | | | | | | | | | | | | ? | P |
| 143 | 24VL379 | Habitation | X | | | | | | | | | | | | | | | | X | | | | | X | | ? | P |
| 143 | 24VL380 | Habitation-Stone Circle | | | 7 | | | | | | | | | | | | | | X | | | | 1 | | | ? | P |
| 143 | 24VL381 | Habitation-Stone Circle | | | 2 | | | | | | | | | | | | | | | | | | | X | | ? | P |
| 144 | 24VL382 | Habitation-Stone Circle Rock Cluster | X | | M | | | | | M | | | | | | | | | X | | | | | | | ? | P |
| 144 | 24VL383 | Habitation-Stone Circle | X | | 29 | | | | | | | | | | | | | | X | | | | | | | ? | P |

| Claim No. | Site No. | Type of Site | F B | H | S C | C | S P | D L | G | R C | SD | H R | PP | B | PE | S | RF | C | Q D | E F | H | S E | C | B D | H D | C P | C P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | 24VL384 | Habitation-Stone Circle | X | | | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 145 | 24VL385 | Habitation | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 145 | 24VL386 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 146 | 24VL387 | Habitation/Cairn | X | | M | 10 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 147 | 24VL388 | Habitation-Stone Circle | X | | 1 | | | | | | | | | | | | | | X | | | | | | | ? | P |
| 147 | 24VL389 | Habitation/Cairn | X | | | 1 | | | | | | | | | | | | | X | | | | | | | ? | P |
| 147 | 24VL390 | Habitation-Stone Circle | X | | M | | | | | | | | | | | | | 1 | X | 7 | | | | X | | ? | P |
| 147 | 24VL391 | Habitation-Stone Circle | X | | M | M | | | | | | | | | | | | | X | 1 | | | | | | ? | P |

[1] The number of features counted and artifacts present at each site is represented by a figure or, in the case of multiple but uncounted features, by an M for multiple. The presence of some features and artifacts is indicated by an X.

[2] P = Prehistoric; M = Middle Period; L = Late Period; PL = Pelican Lake Phase; OW =Old Women's Phase; Pr = Protohistoric; A = Amerindian; R = Recent (Historic); H = Historic.

FBR = Fire Broken Rock
B = Biface
HD = Historic Debris
RF = Retouched Flake
QD = Quartzite Debris
H = Hammer

PR = Projectile Point
BD = Bone Detritus
C = Cairn
DL = Drive Line
RC = Rock Cluster
HR = Historic Ruins

C = Ceramics
SC = Stone Circle
S = Scraper
C = Core
EF = Exotic Flake
SE = Stone Effigy

H = Hearth
PE = Pièce Esquillée
SP = Stone Pile
G = Grave
SD = Surface Depression

# Appendix 3. Archaeological and Historical Sites in the Brazil Creek and Little Beaver Creeks Drainage Area: Baseline Condition, Significance, Potential Effect of Action, and Recommendations.

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 69 | 24VL101 | Undisturbed | 3 | X | | | None |
| 69 | 24VL102 | Undisturbed | 3 | X | | | None |
| 69 | 24VL103 | Severely deflated | 4 | X | | | None |
| 69 | 24VL104 | Undisturbed | 2 | X | | | None |
| 69 | 24VL105 | Rodent disturbance | 4 | X | | | None |
| 69 | 24VL106 | Undisturbed; trail traverses | 4 | X | | | None |
| 69 | 24VL107 | Undisturbed | 4 | X | | | None |
| BLM "A" | 24VL108 | In ruins | 4 | | | X | None |
| BLM "A" | 24VL109 | Undisturbed | 4 | | X | | None |
| BLM "A" | 24VL110 | Severely disturbed | 4 | | X | | None |
| BLM "A" | 24VL111 | Undisturbed | 3 | X | | | None |
| BLM "A" | 24VL413 | Undisturbed | 4 | | X | | None |
| 68 | 24VL112 | Eroding | 4 | | X | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 68 | 24VL113 | Undisturbed | 4 | | | X | None |
| 68 | 24VL114 | Undisturbed | 3 | X | | | None |
| 67 | 24VL115 | Undisturbed | 1 | X | | | None |
| 70 | 24VL116 | Disturbed | 3 | X | | | None |
| 70 | 24VL117 | Undisturbed | 4 | X | | | None |
| BLM "B " | 24VL118 | In ruins | 4 | X | | | None |
| BLM "B" | 24VL119 | Eroding | 3 | X | | | None |
| BLM "B" | 24VL120 | Undisturbed | 4 | X | | | None |
| BLM "C" | 24VL121 | Eroding | 4 | X | | | None |
| BLM "C" | 24VL12 | Undisturbed | 4 | X | | | None |
| BLM "C" | 24VL123 | Undisturbed | 2 | X | | | None |
| School Lease "A" | 24VL124 | Undisturbed | 4 | X | | | None |
| School Lease "A" | 24VL125 | Severely eroded | 4 | X | | | None |
| School Lease "A" | 24VL126 | Eroding | 3 | X | | | None |
| School Lease "A" | 24VL127 | Undisturbed | 3 | X | | | None |
| School Lease "A" | 24VL128 | Undisturbed | 4 | X | | | None |
| School Lease "A" | 24VL129 | Deflated | 4 | X | | | None |
| School Lease "A" | 24VL130 | Disturbed | 3 | X | | | None |
| School Lease "A" | 24VL131 | Undisturbed | 4 | X | | | None |
| School Lease "A" | 24VL132 | Trail cuts; some cairns potted | 3 | X | | | None |
| School Lease "A" | 24VL133 | Exposed | 4 | X | | | None |
| School Lease "A" | 24VL134 | Undisturbed | 4 | X | | | None |
| 1 | 24VL135 | Undisturbed | 2 | X | | | None |
| 1 | 24VL136 | Undisturbed | 4 | X | | | None |
| 1 | 24VL137 | Eroding | 3 | X | | | None |
| 1 | 24VL138 | Eroding | 4 | X | | | None |
| 1 | 24VL139 | Undisturbed | 3 | X | | | None |
| 1 | 24VL140 | Disturbed | 3 | X | | | None |
| 2 | 24VL141 | Undisturbed | 3 | X | | | None |
| 3 | 24VL142 | Disturbed | 3 | X | | | None |
| 3 | 24VL143 | Undisturbed | 3 | X | | | None |
| 3 | 24VL144 | Undisturbed | 3 | X | | | None |
| 3 | 24VL145 | Undisturbed | 3 | X | | | None |
| 3 | 24VL146 | Eroding | 4 | X | | | None |
| 3 | 24VL147 | Undisturbed | 3 | X | | | None |
| 5 | 24VL148 | Undisturbed | 3 | | X | | Map surficial feature |
| 5 | 24VL149 | Disturbed | 4 | | X | | None |
| 6 | 24VL150 | Undisturbed | 3 | X | | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 9 | 24VL151 | In ruins | 4 | X | | | None |
| 10 | 24VL152 | Undisturbed | 2 | X | | | None |
| 11 | 24VL153 | Eroding | 3 | X | | | None |
| 11 | 24VL154 | Undisturbed | 4 | X | | | None |
| 12 | 24VL155 | Undisturbed | 4 | | X | | None |
| 12 | 24VL156 | Undisturbed | 4 | | X | | None |
| 12 | 24VL157 | Eroded | 3 | X | | | None |
| 12 | 24VL158 | Undisturbed | 3 | | | X | Map surficial feature and excavate |
| 12 | 24VL159 | Undisturbed | 4 | | | X | None |
| 118 | 24VL160 | Disturbed | 3 | | | X | Map surficial features and excavate sample |
| Plant Site | 24VL161 | Eroding | 3 | X | | | None |
| Plant Site | 24VL162 | Undisturbed | 3 | X | | | None |
| School Lease "B" | 24VL163 | Eroding | 3 | | X | | Map surficial features |
| School Lease "B" | 24VL393 | Undisturbed | 3 | X | | | None |
| 21 | 24VL164 | Undisturbed | 4 | | | X | Map surficial feature and excavate |
| 21 | 24VL165 | Disturbed | 4 | | | X | None |
| 21 | 24VL166 | Undisturbed | 3 | | X | | Map surficial features |
| 18 | 24VL394 | Eroded | 4 | | X | | Map features |
| 19 | 24VL167 | Severely eroded | 3 | | X | | Map surficial features |
| 19 | 24VL168 | Eroded | 4 | X | | | None |
| 19 | 24VL169 | Eroded | 3 | X | | | None |
| 65 | 24VL170 | Severely eroded | 3 | X | | | None |
| 65 | 24VL171 | Eroding | 2 | X | | | None |
| 22 | 24VL172 | Eroded | 4 | X | | | None |
| 22 | 24VL173 | Eroding | 3 | X | | | None |
| 22 | 24VL174 | Undisturbed | 3 | X | | | None |
| 22 | 24VL175 | Severely eroded | 4 | X | | | None |
| 22 | 24VL176 | Undisturbed | 2 | X | | | None |
| 23 | 24VL177 | Eroding | 3 | X | | | None |
| 23 | 24VL178 | Eroded; cut by mining road | 3 | | X | | Map surficial features |
| 24 | 24VL179 | Undisturbed | 4 | X | | | None |
| 24 | 24VL180 | Eroded | 3 | X | | | None |
| 25 | 24VL181 | Undisturbed | 4 | | X | | None |
| 25 | 24VL182 | Undisturbed | 3 | | X | | Map features |
| 25 | 24VL183 | Eroded | 4 | X | | | None |
| 17 | 24VL184 | Eroding | 4 | X | | | None |
| 71 | 24VL185 | Undisturbed | 4 | X | | | None |
| 71 | 24VL186 | Eroded | 4 | X | | | None |
| 62 | 24VL187 | Undisturbed | 3 | X | | | None |
| 62 | 24VL188 | Disturbed | 3 | | X | | Map surficial features |
| 62 | 24VL189 | Eroding | 3 | | X | | Map surficial features |
| 62 | 24VL190 | Eroded | 4 | | X | | None |
| 63 | 24VL191 | Eroding | 4 | | X | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 63 | 24VL192 | Disturbed | 4 | X | | | None |
| 63 | 24VL193 | Undisturbed | 3 | X | | | None |
| 63 | 24VL194 | Eroding | 3 | X | | | None |
| 63 | 24VL194 | Eroding | 3 | X | | | None |
| 63 | 24VL195 | Eroding | 4 | | X | | Map surficial features |
| 64 | 24VL196 | Eroding | 3 | X | | | None |
| 64 | 24VL197 | Disturbed | 3 | X | | | None |
| 64 | 24VL198 | Disturbed | 4 | X | | | None |
| 61 | 24VL199 | Eroding | 3 | | X | | Map feature |
| 61 | 24VL200 | Eroding | 4 | | X | | Map feature |
| 61 | 24VL201 | Eroding | 3 | | X | | Map surficial features |
| 61 | 24VL202 | Eroding | 3 | X | | | None |
| 60 | 24VL203 | Undisturbed | 4 | | | X | Map surficial features |
| 60 | 24VL204 | Undisturbed | 4 | | X | | None |
| 59 | 24VL205 | Undisturbed | 4 | | X | | Map surficial features |
| 59 | 24VL206 | Eroding | 2 | | X | | Map surficial features and excavate sample |
| 58 | 24VL207 | Undisturbed | 4 | | X | | Map surficial features |
| 73 | 24VL208 | Disturbed | 3 | X | | | None |
| 73 | 24VL209 | Undisturbed | 4 | X | | | None |
| 73 | 24VL210 | Eroding | 4 | | X | | None |
| 73 | 24VL211 | Eroded | 3 | | X | | Map surficial features |
| 27 | 24VL212 | Eroding | 3 | | | X | Map surficial features and excavate sample |
| 27 | 24VL395 | Undisturbed (prospect pit) | 1 | | X | | Map surficial features and excavate sample |
| 74 | 24VL213 | Disturbed | 3 | | X | | Map surficial features and excavate sample |
| 97 | 24VL214 | Undisturbed | 3 | X | | | None |
| 97 | 24VL215 | Eroded | 3 | X | | | None |
| 97 | 24VL216 | Eroding | 4 | | | X | None |
| 26 | 24VL217 | Eroding | 2 | X | | | None |
| 26 | 24VL218 | Eroded | 4 | X | | | None |
| 26 | 24VL219 | Eroding | 2 | X | | | None |
| 26 | 24VL220 | Eroding | 2 | X | | | None |
| 26 | 24VL221 | Disturbed | 3 | | X | | Map surficial features |
| 26 | 24VL222 | Eroding | 2 | | X | | Map surficial features |
| 100 | 24VL223 | Undisturbed | 3 | X | | | None |
| 15 | 24VL224 | Severely eroded | 3 | X | | | None |
| 77 | 24VL225 | Undisturbed | 4 | X | | | None |
| 77 | 24VL226 | Eroded | 3 | X | | | None |
| 28 | 24VL227 | Eroded | 3 | X | | | None |
| 29 | 24VL228 | Eroding | 4 | | X | | Map surficial features |
| 29 | 24VL419 | Eroded | 4 | X | | | None |
| 30 | 24VL229 | Eroding | 4 | X | | | None |
| 30 | 24VL230 | Eroded | 2 | X | | | None |
| 30 | 24VL231 | Eroding | 4 | X | | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 30 | 24VL232 | Eroding | 3 | X | | | None |
| 31 | 24VL233 | Undisturbed | 3 | X | | | None |
| 31 | 24VL234 | Eroded | 3 | | X | | Map surficial features and excavate sample |
| 31 | 24VL396 | Eroded | 4 | X | | | None |
| 32 | 24VL235 | Eroding | 4 | | X | | None |
| 32 | 24VL236 | Undisturbed | 3 | | X | | Map surficial features and excavate sample |
| 33 | 24VL237 | Undisturbed | 4 | X | | | None |
| 34 | 24VL238 | Undisturbed | 1 | | X | | Map surficial features and excavate sample |
| 34 | 24VL239 | Undisturbed | 3 | X | | | None |
| School Lease "C" | 24VL240 | Eroding | 4 | X | | | None |
| School Lease "C" | 24VL241 | Eroding | 2 | X | | | None |
| School Lease "C" | 24VL242 | Disturbed | 3 | X | | | None |
| School Lease "C" | 24VL243 | Undisturbed | 4 | X | | | None |
| School Lease "C" | 24VL244 | Undisturbed | 3 | X | | | None |
| School Lease "C" | 24VL245 | Eroding | 4 | X | | | None |
| School Lease "C" | 24VL246 | Undisturbed | 3 | X | | | None |
| School Lease "C" | 24VL247 | Undisturbed | 4 | X | | | None |
| School Lease "C" | 24VL248 | Disturbed | 4 | X | | | None |
| School Lease "C" | 24VL249 | Undisturbed | 3 | X | | | None |
| School Lease "C" | 24VL250 | Undisturbed | 3 | X | | | None |
| School Lease "C" | 24VL251 | Disturbed | 4 | X | | | None |
| School Lease "C" | 24VL252 | Eroding | 3 | X | | | None |
| 35 | 24VL253 | Undisturbed | 4 | X | | | None |
| 37 | 24VL254 | Eroding | 2 | | X | | Map surficial features and excavate sample |
| 37 | 24VL255 | Disturbed | 3 | X | | | None |
| 37 | 24VL256 | Severely disturbed | 3 | X | | | None |
| 37 | 24VL257 | Eroding | 3 | X | | | None |
| 38 | 24VL258 | Undisturbed | 2 | X | | | None |
| 39 | 24VL259 | Undisturbed | 4 | X | | | None |
| 39 | 24VL260 | Disturbed | 4 | X | | | None |
| 40 | 24VL261 | Undisturbed | 3 | X | | | None |
| 40 | 24VL262 | Severely eroded | 4 | X | | | None |
| 40 | 24VL263 | Severely eroded | 4 | X | | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 40 | 24VL264 | Undisturbed | 3 | X | | | None |
| 42 | 24VL265 | Severely eroded | 3 | X | | | None |
| 42 | 24VL266 | Undisturbed | 3 | | X | | Map surficial features |
| 42 | 24VL267 | Undisturbed | 3 | | X | | Map surficial features |
| 42 | 24VL268 | Undisturbed | 3 | | | X | Map surficial features and excavate |
| 42 | 24VL269 | Eroding | 3 | | X | | Map surficial features |
| 43 | 24VL270 | Eroded | 3 | | X | | Map surficial features |
| 43 | 24VL271 | Eroding | 3 | X | | | None |
| 43 | 24VL272 | Undisturbed | 4 | X | | | None |
| 43 | 24VL273 | Undisturbed | 4 | X | | | None |
| 43 | 24VL274 | Severely eroded | 3 | X | | | None |
| 44 | 24VL275 | Disturbed | 4 | X | | | None |
| 46 | 24VL276 | Eroded | 4 | X | | | None |
| 46 | 24VL277 | Eroded | 4 | X | | | None |
| 46 | 24VL278 | Eroding | 4 | | X | | None |
| 46 | 24VL279 | Eroding | 3 | | X | | Excavate sample |
| 46 | 24VL280 | Undisturbed | 3 | | X | | Map feature |
| 47 | 24VL281 | Disturbed | 3 | X | | | None |
| 47 | 24VL282 | Undisturbed | 2 | X | | | None |
| 47 | 24VL283 | Eroded | 3 | X | | | None |
| 47 | 24VL284 | Disturbed | 4 | X | | | None |
| 47 | 24VL285 | Undisturbed | 3 | X | | | None |
| 47 | 24VL286 | Undisturbed | 3 | X | | | None |
| 47 | 24VL287 | Undisturbed | 4 | | X | | None |
| 47 | 24VL288 | Disturbed | 4 | | X | | Map surficial features |
| 47 | 24VL289 | Undisturbed | 4 | | X | | Map surficial features |
| 47 | 24VL290 | Undisturbed | 3 | | X | | Map surficial features |
| 48 | 24VL291 | Undisturbed | 4 | X | | | None |
| 48 | 24VL292 | Undisturbed | 4 | X | | | None |
| 48 | 24VL293 | Disturbed | 3 | X | | | None |
| 48 | 24VL294 | Eroding | 3 | X | | | None |
| 48 | 24VL295 | Undisturbed | 2 | | X | | Map surficial features and excavate sample |
| 49 | 24VL296 | Deflated | 4 | | X | | None |
| 49 | 24VL297 | Disturbed | 4 | X | | | None |
| 50 | 24VL298 | Partial disturbance | 2 | | X | | Map surficial features |
| 50 | 24VL299 | Partial disturbance | 2 | | | X | Map surficial features |
| 50 | 24VL300 | Partial disturbance | 2 | | X | | Map surficial features |
| 50 | 24VL301 | Undisturbed | 3 | | X | | Map surficial features and excavate sample |
| 50 | 24VL302 | Eroding | 4 | X | | | None |
| 50 | 24VL399 | Undisturbed | 3 | X | | | None |
| 56 | 24VL303 | Eroding | 3 | X | | | None |
| 56 | 24VL304 | Eroded | 4 | X | | | None |
| 45 | 24VL305 | Eroded | 3 | X | | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 45 | 24VL306 | Eroding | 4 | X | | | None |
| 45 | 24VL307 | Undisturbed | 3 | X | | | None |
| 45 | 24VL308 | Eroding | 3 | X | | | None |
| 45 | 24VL309 | Disturbed | 3 | X | | | None |
| 45 | 24VL310 | Undisturbed | 4 | X | | | None |
| 57 | 24VL311 | Undisturbed | 4 | X | | | None |
| 51 | 24VL312 | Undisturbed | 3 | X | | | None |
| 51 | 24VL313 | Disturbed | 3 | X | | | None |
| 51 | 24VL314 | Disturbed | 3 | X | | | None |
| 52 | 24VL315 | Undisturbed | 4 | X | | | None |
| 52 | 24VL316 | Undisturbed | 4 | X | | | None |
| 52 | 24VL317 | Undisturbed | 2 | | X | | Map surficial features |
| 52 | 24VL318 | Eroded | 2 | | | X | Map surficial features |
| 54 | 24VL319 | Disturbed | 2 | X | | | None |
| 54 | 24VL320 | Eroded | 4 | X | | | None |
| 78 | 24VL321 | Undisturbed | 2 | | X | | Map surficial features and excavate sample |
| 78 | 24VL322 | Undisturbed | 3 | | X | | Map surficial features |
| 78 | 24VL323 | Eroded | 3 | | X | | Map surficial features |
| 78 | 24VL398 | Eroding | 2 | | | X | Map surficial features and excavate |
| 79 | 24VL324 | Disturbed | 3 | X | | | None |
| 79 | 24VL325 | Disturbed | 4 | X | | | None |
| 79 | 24VL326 | Undisturbed | 2 | | X | | Map surficial features and excavate sample |
| 79 | 24VL327 | Severely eroded | 3 | X | | | None |
| 55 | 24VL328 | Eroded | 3 | X | | | None |
| 55 | 24VL329 | Undisturbed | 4 | X | | | None |
| 55 | 24VL330 | Disturbed | 3 | X | | | None |
| 80 | 24VL331 | Undisturbed | 3 | | | X | Map surficial features and excavate |
| 80 | 24VL332 | Disturbed | 4 | | | X | Map surficial features and excavate |
| 80 | 24VL333 | Undisturbed | 3 | X | | | None |
| 80 | 24VL334 | Eroding | 2 | X | | | None |
| 81 | 24VL335 | Undisturbed | 3 | | X | | Map surficial features and excavate |
| 81 | 24VL336 | Eroded | 3 | | X | | Map surficial features |
| 81 | 24VL337 | Undisturbed | 4 | | X | | Map surficial features |
| 82 | 24VL338 | Severely eroded | 2 | X | | | None |
| 82 | 24VL339 | Eroding | 4 | | X | | None |
| 82 | 24VL340 | Undisturbed | 4 | X | | | None |
| 82 | 24VL341 | Undisturbed | 4 | X | | | None |
| 83 | 24VL342 | Undisturbed | 3 | X | | | None |
| 83 | 24VL343 | Undisturbed | 3 | X | | | None |
| 84 | 24VL401 | Eroded | 4 | | | X | Map surficial feature and excavate |
| 98 | 24VL344 | Undisturbed | 4 | X | | | None |
| School Lease "D" | 24VL345 | Undisturbed | 3 | X | | | None |
| School Lease "D" | 24VL346 | Undisturbed | 3 | X | | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| School Lease "D" | 24VL347 | Severely eroded | 3 | X | | | None |
| School Lease "D" | 24VL348 | Eroded | 4 | X | | | None |
| School Lease "D" | 24VL349 | Eroding | 3 | X | | | None |
| School Lease "D" | 24VL350 | Undisturbed | 4 | | X | | Map surficial feature |
| School Lease "D" | 24VL351 | Eroding | 2 | X | | | None |
| School Lease "D" | 24VL352 | Undisturbed | 1 | X | | | None |
| 85 | 24VL353 | Undisturbed | 4 | | X | | None |
| 85 | 24VL363 | Eroded | 3 | X | | | None |
| 85 | 24VL400 | Undisturbed | 3 | X | | | None |
| 86 | 24VL354 | Disturbed | 3 | X | | | None |
| 86 | 24VL355 | Undisturbed | 3 | | X | | Map surficial features and excavate sample |
| 86 | 24VL356 | Disturbed | 3 | X | | | None |
| 86 | 24VL357 | Eroding | 3 | X | | | None |
| 87 | 24VL358 | Disturbed | 4 | | | X | None |
| 88 | 24VL359 | Disturbed | 3 | X | | | None |
| 88 | 24VL360 | Disturbed | 3 | X | | | None |
| 88 | 24VL361 | Disturbed | 3 | | X | | Map surficial feature and excavate sample |
| 88 | 24VL397 | Undisturbed | 2 | | X | | Map surficial feature |
| 89 | 24VL362 | Eroding | 3 | X | | | None |
| 90 | 24VL364 | Disturbed | 3 | X | | | None |
| 90 | 24VL365 | Disturbed | 4 | X | | | None |
| 91 | 24VL366 | Undisturbed | 3 | X | | | None |
| 92 | 24VL367 | Disturbed | 4 | X | | | None |
| 92 | 24VL368 | Eroded | 4 | X | | | None |
| 93 | 24VL369 | Weathered | 4 | X | | | None |
| 93 | 24VL370 | Disturbed | 3 | X | | | None |
| 93 | 24VL371 | Undisturbed | 3 | X | | | None |
| 138 | 24VL372 | Undisturbed | 3 | X | | | None |
| 139 | 24VL373 | Disturbed | 3 | X | | | None |
| 139 | 24VL374 | Undisturbed | 2 | X | | | None |
| 139 | 24VL375 | Eroded | 3 | X | | | None |
| 141 | 24VL376 | Undisturbed | 3 | X | | | None |
| 141 | 24VL377 | Eroding | 4 | X | | | None |
| 143 | 24VL378 | Disturbed | 3 | X | | | None |
| 143 | 24VL379 | Undisturbed | 2 | X | | | None |
| 143 | 24VL380 | Disturbed | 3 | X | | | None |
| 143 | 24VL381 | Disturbed | 3 | X | | | None |
| 144 | 24VL382 | Disturbed | 3 | | X | | Map surficial features |
| 144 | 24VL386 | Undisturbed | 2 | X | | | None |
| 145 | 24VL383 | Undisturbed | 4 | X | | | None |

| Claim No. | Site No. | Baseline Condition | Potential Effect of Action[1] | | | | Recommendations[2] |
|---|---|---|---|---|---|---|---|
| | | | Significance Rating | Unknown | Indirect | Direct | |
| 145 | 24VL384 | Severely eroded | 4 | X | | | None |
| 145 | 24VL385 | Undisturbed | 4 | X | | | None |
| 146 | 24VL387 | Eroding | 3 | X | | | None |
| 147 | 24VL388 | Disturbed | 3 | X | | | None |
| 147 | 24VL389 | Undisturbed | 3 | X | | | None |
| 147 | 24VL390 | Undisturbed | 4 | X | | | None |
| 147 | 24VL391 | Undisturbed | 3 | X | | | None |

[1] The "Potential Effect of Action" determination is based exclusively upon proximity factor estimation. Any change in the location of mining pits and/or other associated surface-modifying activity may constitute cause for re-evaluation of projected impact and a corresponding alteration in protective recommendations.
[2] Listed "Recommendations" are contingent upon the determination of proximity and the independent evaluation of significance. Any change in the proximity factor can potentially alter the "Recommendation."

# Appendix 4. Archaeological Terms and Concepts

Current archaeological endeavor and inquiry is a complicated, multi-faceted, integrative technical and humanistic discipline. Among the goals of contemporary archaeology is the sensitive reconstruction of the manner in which prehistoric peoples lived and interacted with the external environment. The lifeways of those hunter-gatherer populations that were adapted to the resources of the High Plains area of northern Montana for more than 11,000 years present many problems of interpretation. The relative youth of the science as applied to the Northwestern Plains region and the pressures and opportunities created by accelerating surface modification reveal archaeology, as here applied to practical problemsolving, in its eager infancy. Certain terms and concepts expressed in this study, as an extension of the language, perspectives, and methods of archaeology, are identified and explained in operational terms below.

An archaeological site is the scene of prehistoric human activity as it is indicated by artifacts and/or ecofacts. Sites occupy more or less space, depending upon the nature of the activities that occurred at each, the number of people involved in the activities, the duration of the activities, the manner in which physical and social space were allocated by each culture, and the kinds of natural resources (animal, vegetable, mineral, water) that were sought and/or utilized there. Sites differ in several basic ways: stratified sites are those at which two or more prehistoric (or prehistoric and historic) events occurred through time; such sites are characterized by residues that are separated today by culturally sterile sediments; single component sites are those that were occupied on one or more occasions by the same archaeological culture; multiple component sites were occupied on more than one occasion by two or more different archaeological cultures. Stratified sites may have either single or multiple-components.

Artifacts are natural organic or mineral substances that were used in their natural or modified state by prehistoric people for various purposes. Artifacts include implements and the waste that resulted from tool production. Artifacts are movable and they can therefore be collected for study.

Features are artifacts that are immovable, such as modified objects or structures that were fashioned in place by prehistoric papally Cairns, stone circles, stone piles, stone alignments, and fire hearths are common local feature.

Ecofacts are discarded animal or plant remains from which ecological facts can be inferred. The bones of animals that survive as evidence of food processing activities, for example, are ecofacts. The species of processed animals represented by bone can be identified from the bony remains. The habitat to which each species was adapted is known. Therefore, the nature of the environment, at the time man was utilizing its resources during prehistory, can be reconstructed reliably.

Artifacts and ecofacts are associated when the physical relationship between them at the time those remains were deposited as a result of human activity during prehistory has been preserved. The term in context refers to preserved original associations. When associations are preserved or in context, they are said to possess integrity. Any disturbance of the original physical relationships among artifacts and ecofacts alters the integrity of the associations and modifies the context to the detriment of the buried record.

Archaeological cultures are prehistoric lifeway constructs that are inferred from the physical evidence (artifacts, features, ecofacts, and associations) that are developed, analyzed, and interpreted by archaeologists. Inference of past human behavior at the cultural level of complexity is dependent upon relatable historical facts, archaeological evidence, anthropological assumptions about the nature and dynamics of culture, and theoretical orientations peculiar to archaeological reconstructive methods. In reality, by virtue of the unavoidable reliance upon material culture (artifacts and features), archaeologists identify and isolate complexes and phases within techno- logical traditions.

The term culture complex applies to earlier cultures, the cultural inventory and characteristics of which are not as yet well known. Culture complexes distribute over large or indefinite geographic areas within uncertain time boundaries.

A culture phase (Willey and Phillips 1958:72) is an "archaeological unit possessing traits sufficiently characteristic to distinguish it from all other units similarly conceived whether of the same or other cultures." Phases thus correlate generally with localities or archaeological regions, such as the Northwestern Plains region. In Reeves' (1970:22) view, the comprehensive culture sequence that is followed herein, a phase does not necessarily equate with a locality, region, or even an area; the "area occupied by a phase may change through time and it may in fact be found in environmentally distinct areas." Phase names have been assigned to many of the archaeological cultures identified in the Northwestern Plains beginning with Middle Prehistoric period cultures.

An archaeological tradition (Willey and Phillips is "a (primarily) temporal continuity represented by Persistent configurations in single technologies or other systems of related form" Reeves (1970:22) prefers to regard "cultural tradition[s] as persistent configurations in a number of cultural systems, which interact to produce an archaeological unit distinct from all other archaeological units conceived on the same criteria." The concept of tradition serves to integrate successive phases historically as cultural units within an ongoing space-time adaptive continuum.

## Valley County Records

Index to Deeds
Deed Books
Patents Books
Miscellaneous Record Entries
Oil and Gas Lease Books

## Personal Communications

Kelly Hammond, Bureau of Land Management, Billings, Montana. October, 1976.

Bud Lee, Bureau of Land Management, Billings, Montana. October, 1976.

Edna Haverland, Bureau of Land Management, Billings, Montana. October, 1976.

Albert Fee Czarnowski, Area Mining Supervisor, U. S. Geological Survey, Billings, Montana. October, 1976.

Gary Gertz, Area Resource Manager, Bureau of Land Management, Malta, Montana. October, 1976.

Gladys Silk, Glasgow Courier, Glasgow, Montana. October, 1976.

Bonnie Fifield, Valley County Abstract Company, Glasgow, Montana. October, 1976.

Ronald W. Eliason, Raw Materials Manager, Federal Bentonite, Aurora, Illinois. November, 1976.

Roy Dunbar, Soil Conservation Service, Glasgow, Montana. December, 1976.

T. J. Reynolds, Water Rights Bureau, Department of Natural Resources, Helena, Montana. December, 1976.

## Endnotes

1. From archaeological and historical site records available in the "Montana Historic Preservation Plan with Historic Sites Compendium," 2nd Edition, Vols. I, II, and III, prepared by the Montana Fish and Game Commission, 1975. Helena.
2. Much of the basic technical information upon which this synoptic discussion relies was derived from "Siting Energy Facilities at Glasgow Air Force Base," a four-volume report prepared for the General Energy Administration in 1975 by the Montana Energy and MHD Research and Development Institute, Inc., Butte.
3. Milk River Land Planning Report, 1960, p. 8.
4. Ibid., p. 51.
5. Agricultural Planning, 1941, p. 6.
6. Ibid., p. 7.
7. Preliminary Milk River Report, 1953, pp. 23-24.

8. Ibid., p. 26.
9. Milk River Land Planning Report, 1960, p. 108.
10. Ibid.
11. Agricultural Planning, 1941, p. 30.
12. Ibid.
13. Ibid., p. 24.
14. Ibid.
15. Preliminary Milk River report, 1953, p. 5.
16. Milk River Land Planning Report, 1960, p. 119.
17. Agricultural Planning, 1941, p. 30.
18. Milk River Land Planning Report, 1960, p. 67.
19. U. S. Department of Interior Geologic Survey Individual Well Records, Serial #057503 and 12/9/54.
20. Valley County Lease Book 7, p. 156.
21. Milk River Land Planning Report, 1960, p. 77.
22. Valley County Lease Book 42, pp. 151 and 283.
23. U. S. Department of Interior Geologic Survey Individual Well Records, Serial #s 1833, 1-1028, 19866, 8951, 8943, and 3/16/71.
24. Personal Communications: Roy Dunbar and T. J. Reynolds.
25. Valley County Affidavit M 17851.
26. Personal Communication, Ronald W. Eliason.
27. Personal Communication, Eliason.
28. The phrase "reserved natural and cultural heritage resources" is used here in an attempt to provide a label satisfactory for the lumping of paleontological fossils with prehistoric and historic cultural resources. Paleontological fossils are referred to as "usual" resources in documents that attempt to relate them, for protective purposes, to the respective antiquity laws under which they are accorded special protected status.
29. Pursuant to information contained in BLM Instructional Memorandum No. 76-445 of 19 August 1976.
30. Sites 24VL132 and 24VL349 are characterized by the presence of archaeological and historical remains. The historical residues of these sites are defined as prehistoric for present purposes.
31. Valley County Patents Book 5, p. 447.
32. Valley County Warranty Deed Book 31, p. 170.
33. Valley County Miscellaneous Record Entry #1097.
34. Valley County Warranty Deed Book 46, p. 581.
35. Valley County Patents Book 7, p. 528.
36. Valley County Deed Book 46, p. 440.
37. Personal Communication, Gertz.
38. Valley County Lease Book 7, p. 156.
39. Valley County Lease Book 42, pp. 151 and 283.
40. Valley County Affidavit M 17851.
41. Valley County Miscellaneous Record Entry Book 52, p. 171.
42. Valley County Miscellaneous Record Entry Book 52, p. 353. U.S.D.I. Bentonite Prospecting Permit Montana 073728.
43. Valley County Miscellaneous Record Entry Book 52, p. 356.
44. Personal Communication, Czarnowsky.
45. Personal Communications: Fifield and Haverland. Preliminary Milk River Report, 1953. Public Domain Map.
46. Useful technical approaches to the description, study, and analysis of stone circles and rock clusters are represented by the following references: Smith, Marc B. "A Rapid Method for Field Recording Stone Circles," *Archaeology in Montana* 15(3):47-54, 1975; Aaberg, Stephen. "Comprehensive Stone Circle Mapping," *Archaeology in Montana*, 16(2&3):1-12, 1976; Dormaar, John. "Effect of Boulder flow on Soil Transformation Under Tipi Rings," *Plains Anthropologist* 21(72):115-118, 1976.
47. The importance and utility of lithic types for distributional studies in the Northwestern Plains are exemplified by the following sources: Wedel (1961); Clayton, Lee, W. B. Bickley, Jr., and W. J. Stone. "Knife River Flint," *Plains Anthropologist* 15(50), Part 1, pp. 282-290, 1970; Davis (1966, 1972): Johnson and Roper (1974); Fredlund, Dale. "Fort Union Porcelanite and Fused Glass: Distinctive Lithic Materials of Coal Burn Origin on the Northern Plains," *Plains Anthropologist* 21(73):207-211, 1976; Frison, George C., G. A. Wright, J. B. Griffin, and A. A. Gordus. "Neutron Activation Analysis of Obsidian: An Example of Its Relevance to Northwestern Plains Archaeology," *Plains Anthropologist* 13(41):209-217, 1968; Loendorf, Lawrence. *Prehistoric Settlement Patterns in the Pryor Mountains, Montana*. Doctoral Dissertation, The University of Missouri-Columbia, 1973.
48. Assessment criteria and significance rating criteria and levels are prescribed in draft guidelines formulated by the BLM as "Cultural Resource Evaluation System (CRES)" as Manual Release 6410.
49. These evaluative and significance criteria were applied in a manner consistent with a prior application to sites recorded for the BLM in the Missouri Breaks area in 1975 (Davis 1976).
50. Assessment criteria and significance rating criteria and levels are prescribed in draft guidelines formulated by the BLM as "Cultural Resource Evaluation System (CRES)" as Manual Release 6410.
51. See Curtis 1976.
52. Two sites (24VL163 and 24VL350) located on state school lease claims "B" and "D," respectively, will be

indirectly affected by projected mining operations in federal claims 118 and 84. That eventuality may be precluded by managing agencies, of course.

53. The specification of a "none" recommendation for heritage sites covered by this report refers to their status relative to projected mining developments and the negative prediction of impact on these sites. Managing agencies are urged to take every step possible to discourage the further degradation of all inventoried heritage manifestations in the study tract.
54. An earlier version of this report (Davis 1976) was submitted to Ecological Consulting Services, Inc., on behalf of the Aurora Metal Company, Federal Bentonite Division, by Montana State University, in fulfillment of a contract for technical services (G&C274). This revision is Volume I of two volumes.

# Dog-Days Settlement, Subsistence, and Ceremony at Thompson Bottom

*Leslie B. Davis, Stephen A. Aaberg, Robert J. Ottersberg, Ann M. Johnson, T. Weber Greiser, Michael C. Wilson, John W. Fisher, Jr., and Marc B. Smith*

## Acknowledgements

The Bureau of Land Management, facilitated by Burton D. Williams, Area Archaeologist, provided funds that supported sedimentological and morphological analyses by Robert J. Ottersberg and faunal analysis by Michael Wilson and T. Weber Greiser. Davis is especially grateful to Stanley J. Olsen who provided his expertise gratis regarding the taxonomic identity of utilized canid remains when needed to fulfill terms of the initial BLM contract.

The stable isotopes and obsidian artifact studies were supported by MSU Faculty Development/Creativity Awards granted to Davis, as well as by the originally contracted research project with the BLM and indirectly by a subsequent National Park Service contract with the Museum of the Rockies.

Richard M. Anderson of Fort Benton, Montana, owner of the Thompson Bottom site, permitted access and had overburden stripped from what became the hand-excavated area; he later backfilled the excavation with his backhoe. The excavated biological and artifactual materials, associated records, variously held at the BLM Curation Center in Billings, in the MSU Archaeology Laboratory in Wilson Hall, and in the Museum of the Rockies, were partially delivered to Mr. Anderson in November 1997 per his request. Later, the remaining potsherds were sent to him.

We are grateful to those BLM river rangers who monitored the site during low water following our departure in spring 1977. By so doing, they recovered the "ceremonial" notched biface, possibly a trade item, and an additional four canid crania (specimens C-64 through C-68 herein) from the shoreline.

Garvey and William Wood of Loma, Montana, kindly transported Davis and Ottersberg to Thompson Bottom in the spring of 1979 by motorized canoe.

Marc B. Smith and Robert J. Ottersberg prepared the line drawings, which were finalized by Bruce Eng. Photography by Bruce Selyem, Museum of the Rockies Photographer, is utilized extensively, with written permission, in this report. Diane Fuhrman expertly wordprocessed the manuscripts through several versions and assisted with monograph production.

## List of Figures

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# Introduction

*Leslie B. Davis*

When President Gerald Ford signed Public Law 94-486 on 12 October 1976, the Wild and Scenic Rivers Act (PL 90-542) was amended to include the 240-km reach of the Upper Missouri River between Fort Benton and Fred Robinson Bridge in the National Wild and Scenic River System. The Bureau of Land Management was assigned management responsibility by the Secretary of the Interior. This area was considered a prime segment of the 6,000-km route of the Lewis and Clark Trail.

The Thompson Bottom archaeological site was first investigated in 1975 (Davis 1976) by archaeologists from Montana State University, directed by Les Davis. This work was undertaken under contracts with the Bureau of Land Management. Followup investigations in 1977 were designed to develop further archaeological information useful for interpreting the Precontact human use of this major river valley bottom corridor through the Northwestern Plains (Davis and Aaberg 1978). A field camp was established there on private property in 1997.

This buried, successively occupied, single-component open-air occupation site is contained within the southwestern aspect of an eroding, extensive bottomland that lies along the right bank of the Missouri downstream from Virgelle, Montana. Evidence of buried cultural deposits had been observed in this cutbank periodically since 1972 (Figures 1-4); that eroding terrace was examined closely on each occasion when Davis floated the river prior to 1975 with friends from Havre and Billings. Periodic monitoring was followed in 1975 by an effort to define the cultural stratigraphy and to sample the contents of the most prominent occupation. The cutbank was explored at the outset of work while the wet countryside dried to permit the delivery of power equipment to facilitate deep and extensive excavation. Floaters who had dared the floodwaters before we could begin work at site 24CH452 damaged some of the freshly exposed archaeological ash and charcoal-filled buried firehearths.

**Figure 1.** Narrow, u-shaped, charcoal-filled hearth exposed by erosion in 1974 (Ray Robison, avocational archaeologist, Lewistown).

**Figure 2.** Elongate cross section of charcoal and ash-filled feature exposed in 1974 (Richard Hurd, avocational archaeologist, Big Sandy).

**Figure 3.** Feature at left during profiling of terrace, Les Davis shown.

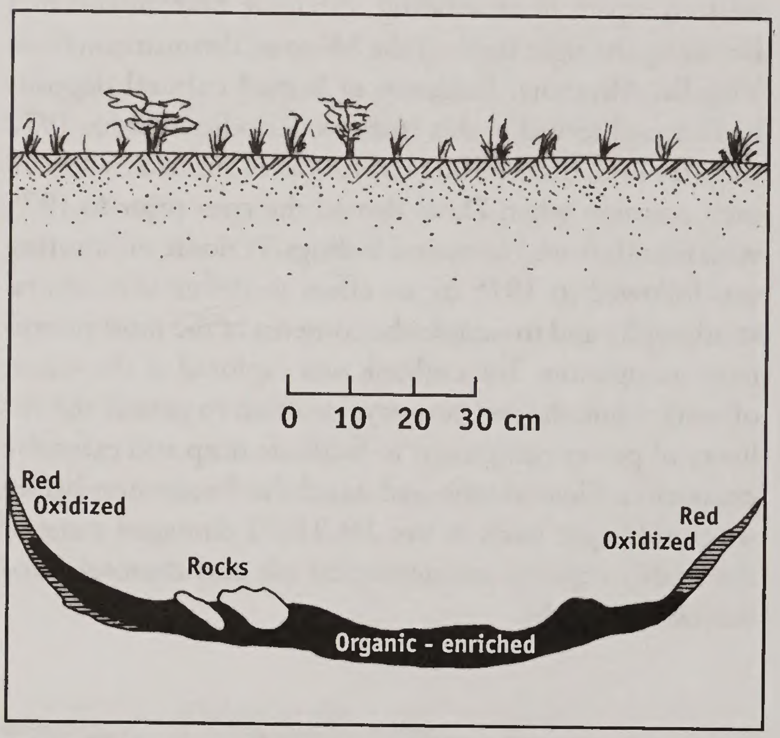



**Figure 4.** Detailed drawing of above figure, with red-oxidized feature margins and interior stones in situ.

Angus Ayers (Fort Benton) stripping overburden to facilitate archaeological excavation at Thompson Bottom.

# Site Formation

*Robert J. Ottersberg*

## Background

The Missouri River in north-central Montana flowed north of the Little Rocky Mountains until Wisconsinan advances of Continental ice forced it to carve a new channel to a more southerly route where it presently flows (Calhoun 1906; Alden 1932; Colton et al. 1961). The very youthful character that resulted from rapid downcutting into soft Upper Cenozoic-age sediments by the Missouri gave it dissected topography. Terrace formation began along the river once a gradient adjusted to base level was reached in Early Holocene times. Modern terraces and channel patterns indicate development of characteristics associated with maturing stream channels. In the stretch between Little Sandy Creek and the western end of Fort Peck Reservoir, several Late Holocene artifact-bearing terraces have been archaeologically investigated (Davis 1976; Davis and Aaberg 1978). When the instability and recency of many terraces were realized, studies were initiated to record and interpret local cultural history, and to monitor and mitigate progressive loss of archaeological deposits to erosion by the meandering river (Davis et al. 1982). A suggestion made (Davis 1976:111; Davis and Aaberg 1978:163) regarding the possibility of correlating occupations and physical stratigraphy along the upper Missouri across diverse floodplain locations had predicted that the intensive study of soils and sediments at such sites might be a useful tool by which to relate one site to others and to make predictions regarding other artifact-bearing deposits in the floodplain.

Pedologic studies combining the disciplines of soils and geomorphology with archaeology are useful in describing past environments. Soil chemistry and morphology are a reflection of man's activity as one of the influential organisms, along with climate, geology, topography, organisms and time, as was recognized by Jenny (1941). Properties of soils and sediments, such as particle-size distribution, reflect the history of landform development. Type and arrangement of fluvial and alluvial deposits are a result of many factors associated with river dynamics (Morisawa 1968). Soil chemistry and morphological and mechanical properties of sediments were used in this study to improve understanding of the formational history of three archaeological sites incorporated in post-glacial Missouri River terraces.

Thompson Bottom, near the upper end of this stretch of the Missouri River, was analyzed in detail and compared to previously developed evidence from the Holmes Terrace and Lost Terrace (Davis 1976; Davis and Aaberg 1978) archaeological sites located farther downstream. Geomorphic and geologic factors characteristic of the Missouri River drainage were analyzed to learn to what extent and in what ways depositional processes and products at the three sites can be interrelated for archaeological reconstructive purposes.

### Location

Archaeological site 24CH452 lies in the upper end of the Missouri River where downcutting was initiated by Wisconsin-age glaciation (Alden 1932). Thompson Bottom is located upstream from the Lost Terrace and Holmes Terrace sites, in the middle of this stretch (Figure 5). Most of the lower stretch has been inundated by Fort Peck Reservoir. Thompson Bottom is located in the SE1/4NE1/2 Sec. 3 T26N R12E, about 8.1 km downstream from the point where the pre-Wisconsin Missouri channel once flowed northward (Figure 5).

The Thompson Bottom site is situated on a broad floodplain which is in the process of becoming a terrace on the south side of the Missouri River channel. The colluvial and alluvial slopes above the terrace gently climb to steep walls of a canyon approximately .8 km wide and 300 m deep. Islands, common in this stretch, are channel bars (Reineck and Singh 1980) that developed during high-water stages and were later raised by flood deposits. These features are characteristic of a braided river. The valley floor also shows meander scars of a mature river, but the terrace on which the site is located has the appearance of being a sediment bar associated with a youthful, straight channel pattern (Reineck and Singh 1980).

### Geology

All unconsolidated sediments adjacent to the site are of Quaternary age and they include alluvium (Figure 5, Qal) and colluvium (Figure 5, Qc) (Lindvall 1956). Adjacent steep slopes of the canyon consist of gently dipping to flat-lying soft sediments of the Late Cretaceous-age Eagle

Sandstone which underlies Clagget shales. Glacial deposits cap the gently rolling plains outside the canyon. Tertiary-age thrust-faulting had upturned the Late Cretaceous beds at several places in the vicinity of the site (Figure 5). These fault lines are associated with a broader set of faults that circumscribe the Bearpaw Mountains and appear to have strongly influenced the southeasterly direction of the Missouri downstream from the site (Figure 4). Locally, the faults are not active, but mass failures upstream (Figure 5) are associated with the deformation zone of a fault where it crosses an exposure of soft Colorado shales (Figure 5).

# Analysis of Sediments

## Morphology

In the Spring of 1984, a face of the terrace cutbank was prepared at the northeast corner of the original excavation unit at the Thompson Bottom site, which had been emplaced years earlier (Davis 1976). Morphology was briefly noted in the field, and samples were taken, for further description and laboratory analysis, from pedogenic, geologic, and archaeologic horizons to a depth of about 3 m, at which

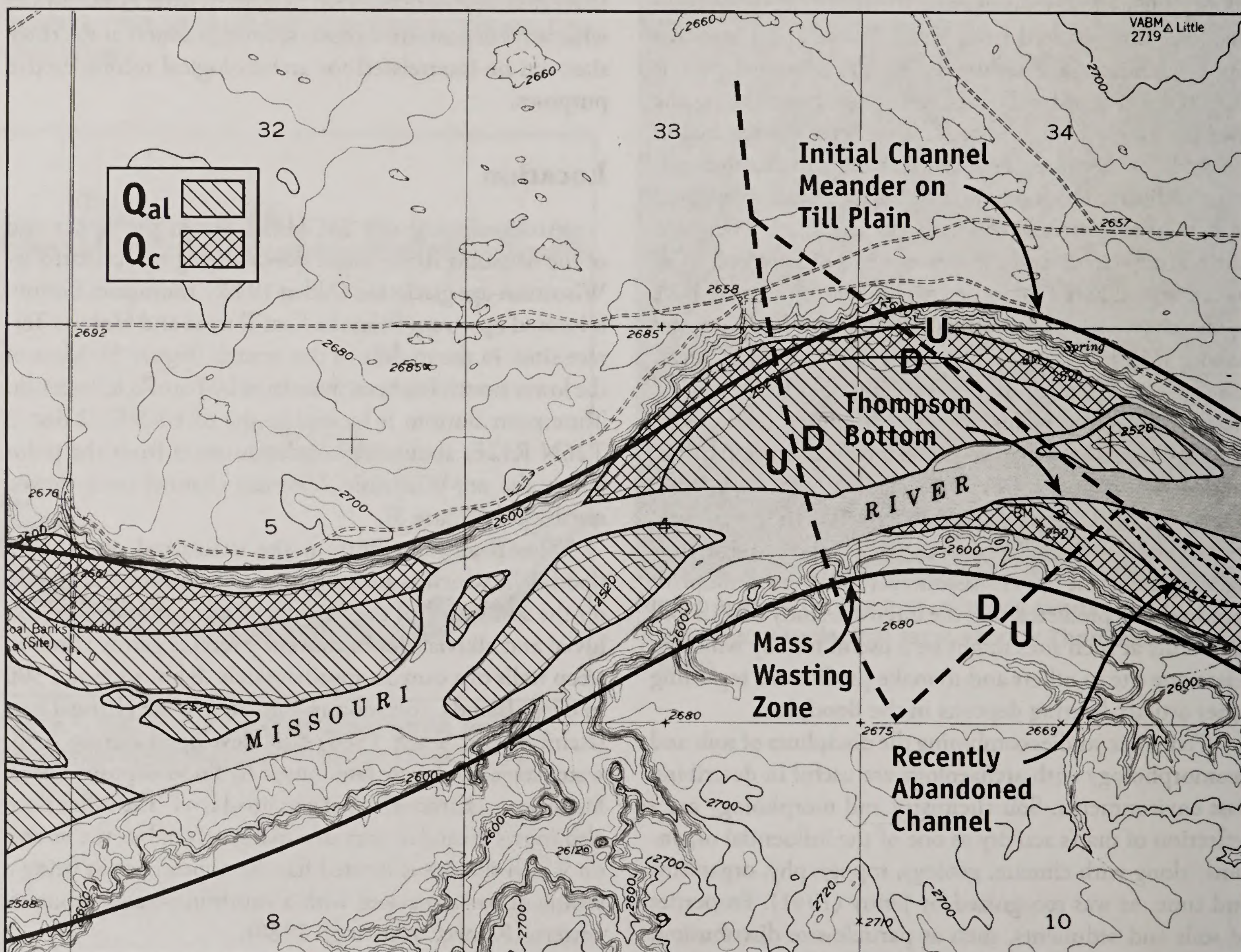



**Figure 5.** Distribution of Late Cretaceous-age and Quaternary-age sediments with respect to local faulting in the vicinity of Thompson Bottom.

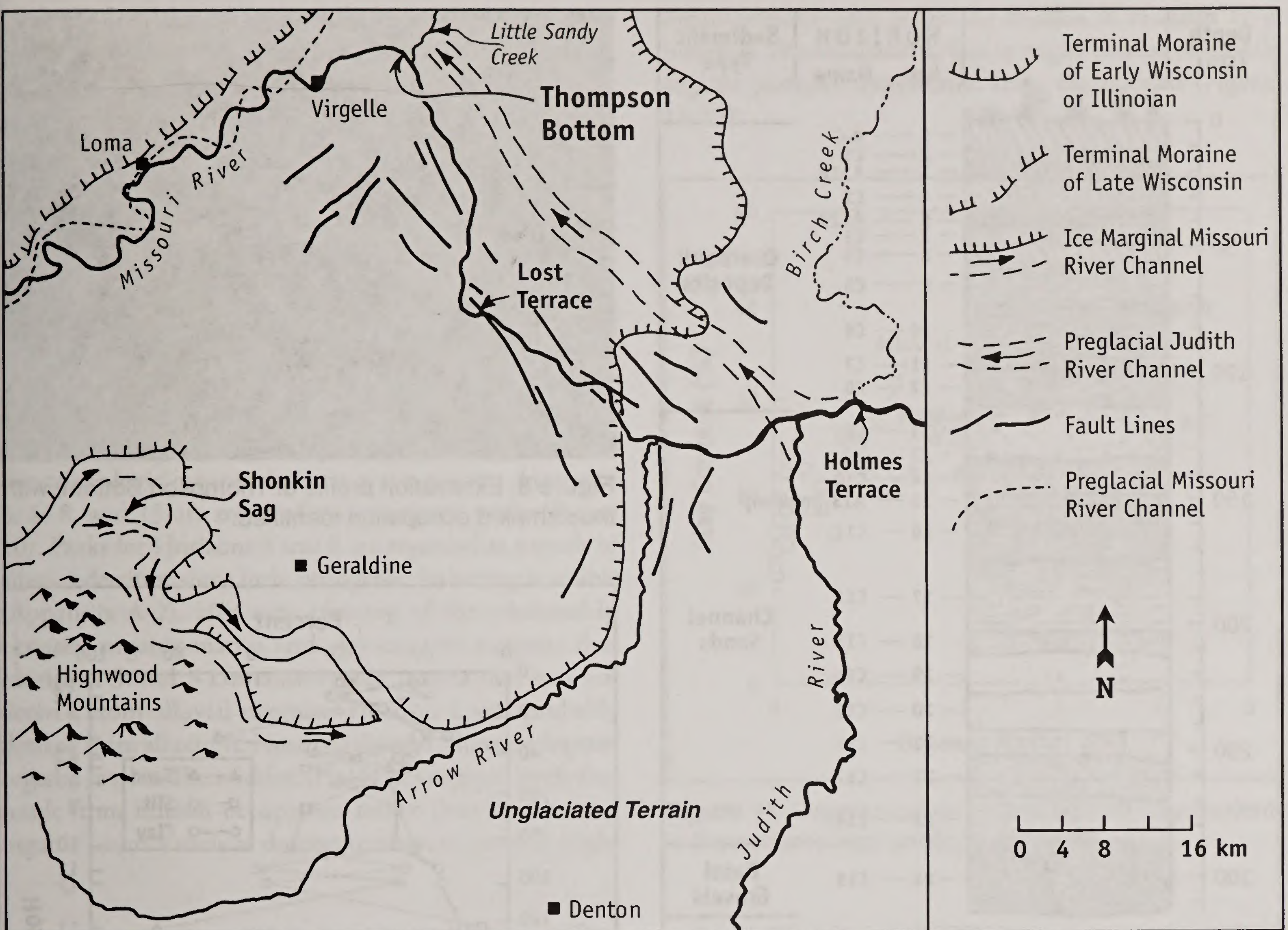



**Figure 6.** General structural and glacial geology map of the Thompson Bottom, Lost Terrace, and Holmes Terrace archaeological sites along the Upper Missouri National Wild and Scenic River in north-central Montana (after Alden 1932).

depth basal channel gravels were reached. Two horizons of organic-matter enrichment associated with pedogenic processes are present above the highly organic-enriched bone midden at 1.5 m (Figure 7) below surface. Nearly all other horizons are geologic deposits differentiated by variations in texture associated with differing flow regimes in a fluvial setting. Little or no evidence of soil development is present.

Eight horizons (10, 12, 14-18, and 20) yielded evidence of secondary deposits of lime (Appendix A-1). Groundwater from the Missouri carries $CaCO_3$, which may be the major source of lime. Most horizons bearing lime occur below Horizon 9; lime could be transferred from groundwater by capillary flow to an evaporating surface, causing a localized secondary lime accumulation.

Effervescence is strong for most horizons with secondary lime accumulations. The midden (H-15 and H-17) just below it have a violent effervescence that shows abnormally high lime levels, possibly explained by the abundance of archaeological bone in the midden, some of which may be partially decomposed.

Two other horizons with violent effervescence because of elevated lime content may be associated with pedogenic lime translocation. Horizon 7 is subjacent to one of three buried surfaces, as indicated by pedogenic organic-matter accumulation. Horizon 10 has abundant lime that may be associated with the top of a watertable, or that horizon may have been located below a surface horizon that had been removed by flood-scouring.

A watertable has existed to within 1 m of the present surface, as indicated by rust-colored mottles in Horizons 10 and 12 (Appendix A-1).

Morphology of the sediments is typical of the weak soil development found in a floodplain setting that receives regular fluvial deposits which inhabit soil development. The top horizon is designated A-C because it has a relatively low organic-matter accumulation, has few other morphological indications of A-horizon development, and looks much like

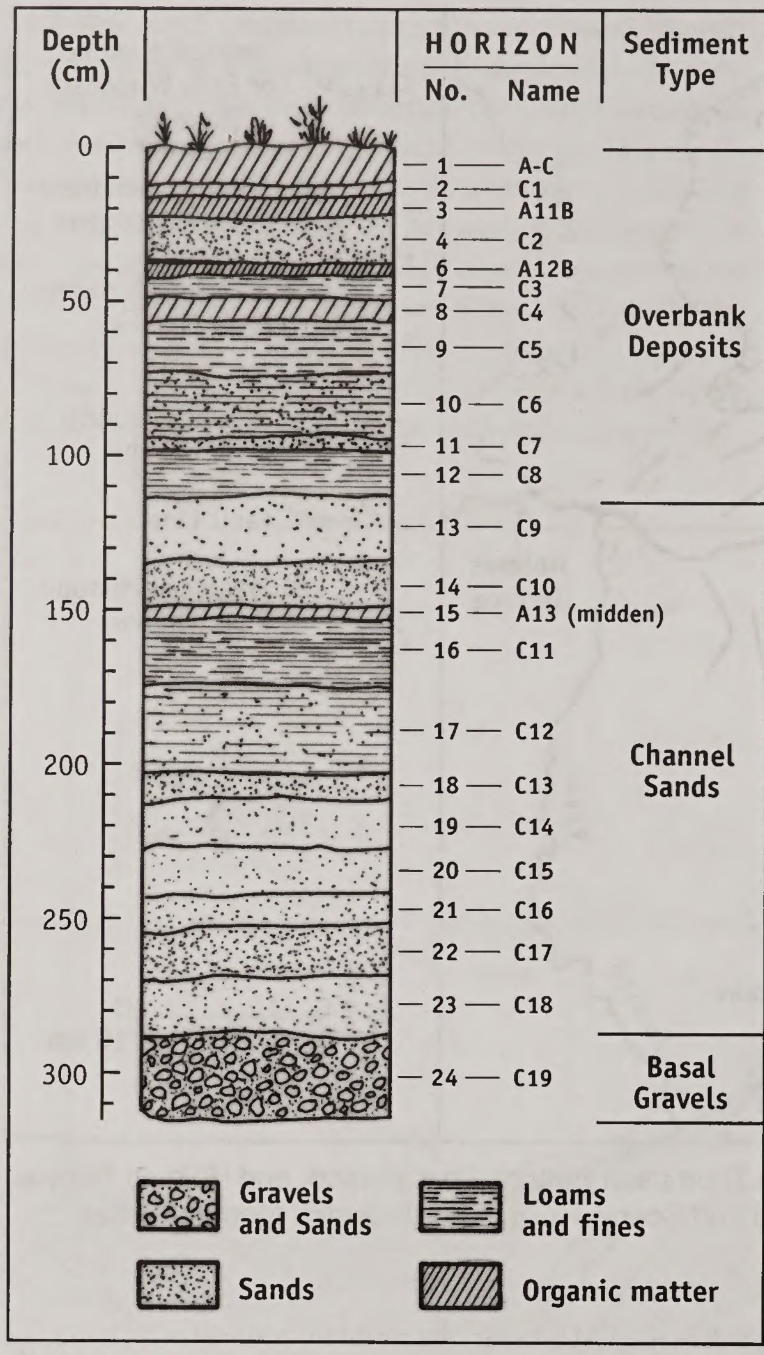



Figure 7. Diagrammatic cross section of sedimentary profile.

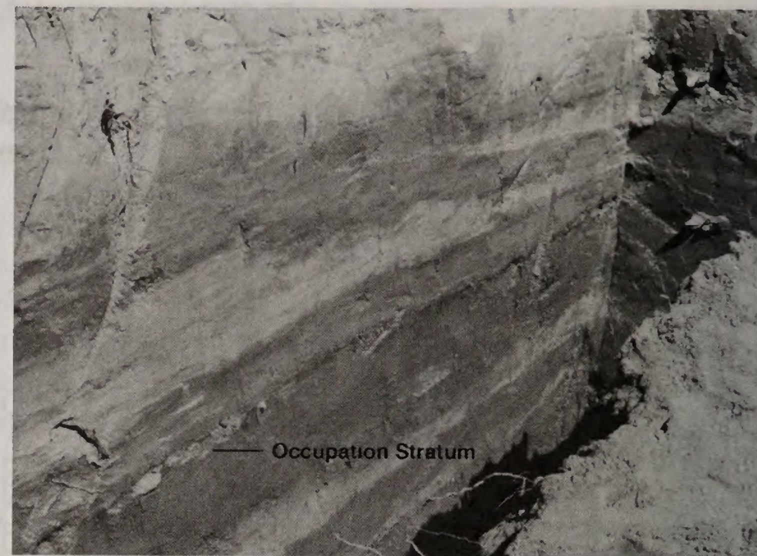



Figure 8. Excavation profile of Thompson Bottom, with the sampled occupation identified.

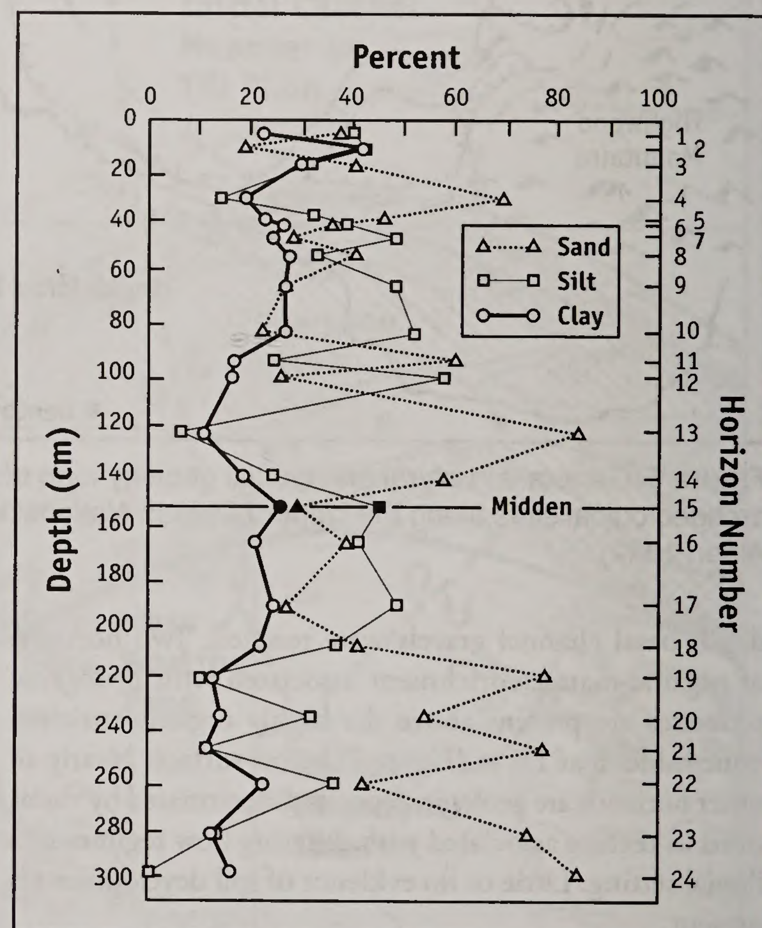



Figure 9. Mechanical analysis of sediments.

the unweathered C-horizons below. The soil classifies as a Typic Ustifluvent, which reflects the weak development associated with soils of the Entisol order (Soil Survey Staff 1975).

Figure 8 displays the predominant midden deposit investigated at Thompson Bottom.

## Mechanical Analysis

Texture was determined by both the hand-feel method and by mechanical analysis of the fines (.2 mm) using a Bouyucos hydrometer in the Montana State University, Department of Plant and Soil Sciences, Soil Testing Laboratory. Textures range from loamy sands and sandy loams near the basal gravels to silt loams and silty dry loams in the upper 2 m (Appendix A-2). Only Horizon 4 in the uppermost meter is as coarse as horizons below Horizon 10 (Figure 9). Several horizons below Horizon 10 are relatively fine (Figure 9).

The coarsest textures of sediments in the bottom-most meter are regarded as slow-water channel deposits with some nearly still-water deposits (Figure 9). Above that are

overbank flood deposits, primarily from still water. Coarse fragments (.2 mm) are absent above the 3-m level, indicating the probable absence of fast-water channel deposits or fan deposits above that level. Cross-bedding in Horizon 13 above the midden suggests one period of either overbank flooding as a channel deposit or the presence of a sand dune (Reineck and Singh 1980).

## Chemical Analysis

Organic matter was determined using an altered dichromic-acid digestion technique (Sims and Haby 1971). Organic matter content of the horizons is similar to estimates made based on morphology; however, variation due to geologic organic deposits is also present. Horizons 3, 6, 8, and 15 are zones of major organic peaks (Figure 10). Peaks for Horizons 3 and 8 are regarded as a result of alluvial detritus, since little pedogenic darkening is visible (Appendix A-2). However, plotting of the relationship between organic-matter and clay content suggests that Horizons 3 and 8 contain organic matter that was not derived from alluvial deposits. Horizon 2 was probably derived from alluvium. Horizons 6 and 15 have pedogenic organic matter. The midden (H-15) has organic levels that result from human occupation rather than non-human organic sources such as decomposed grass roots. A slight organic-matter peak below the midden in Horizon 17 is probably alluvial detritus, but it might consist of mobile organic particles translocated from the midden (Figures 11-13).

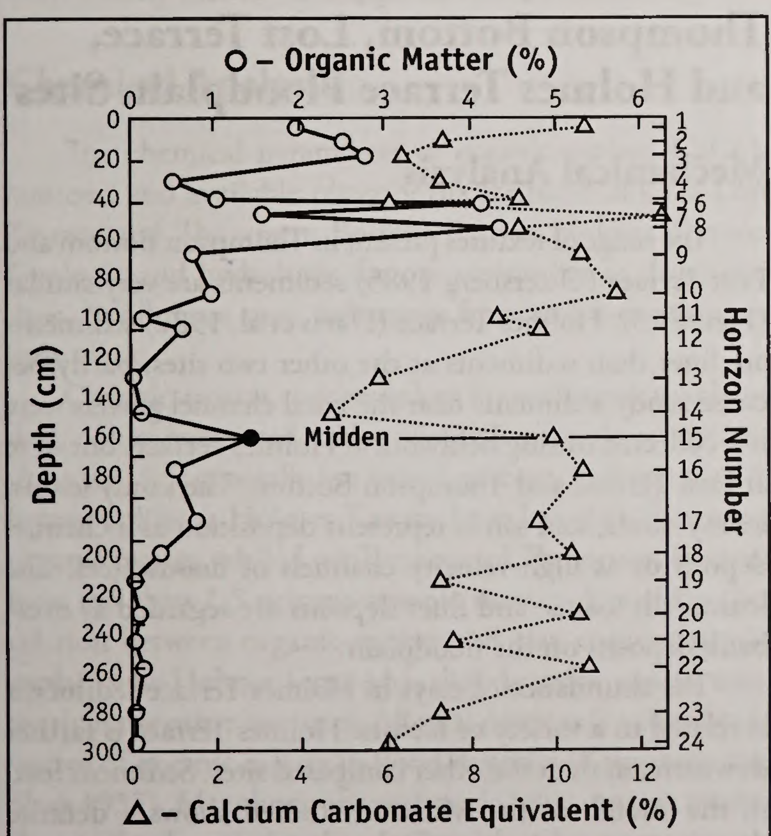



Figure 10. Organic-matter and $CaCO_3$ content of sediments.

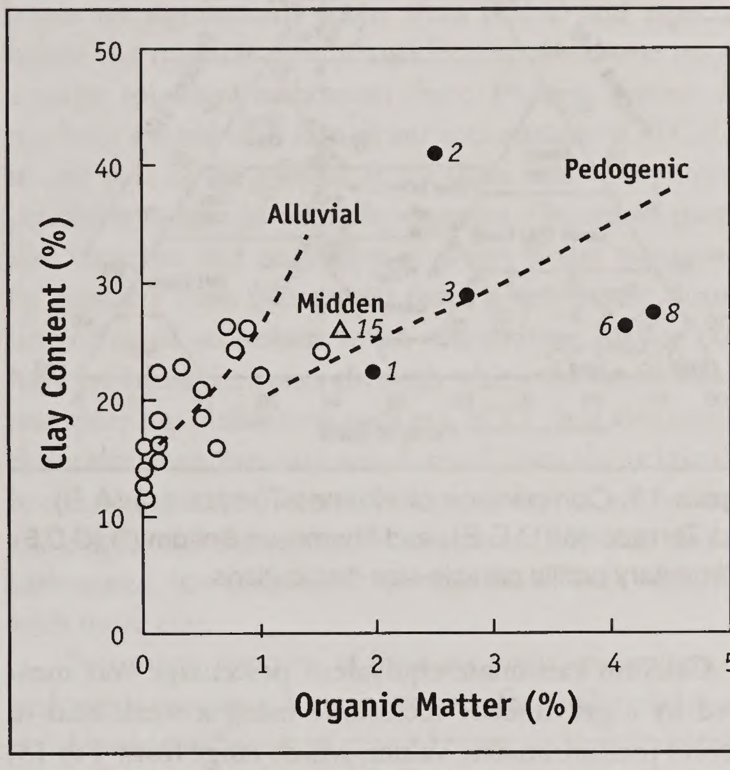



Figure 11. Organic matter plotted against clay content in the sediment/soil stratigraphic profile.

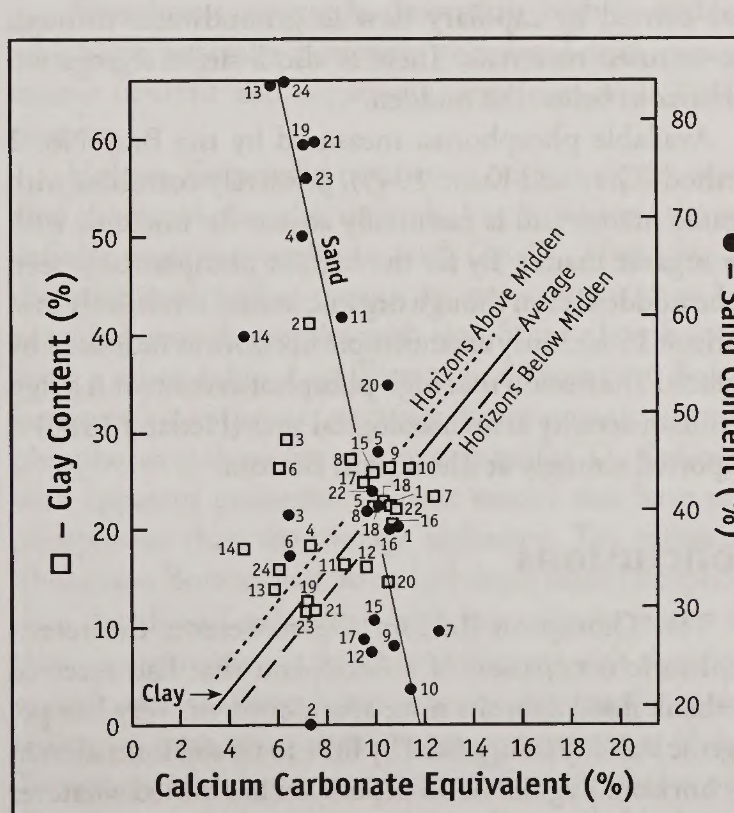



Figure 12. $CaCO_3$ equivalent plotted against clay and sand content.

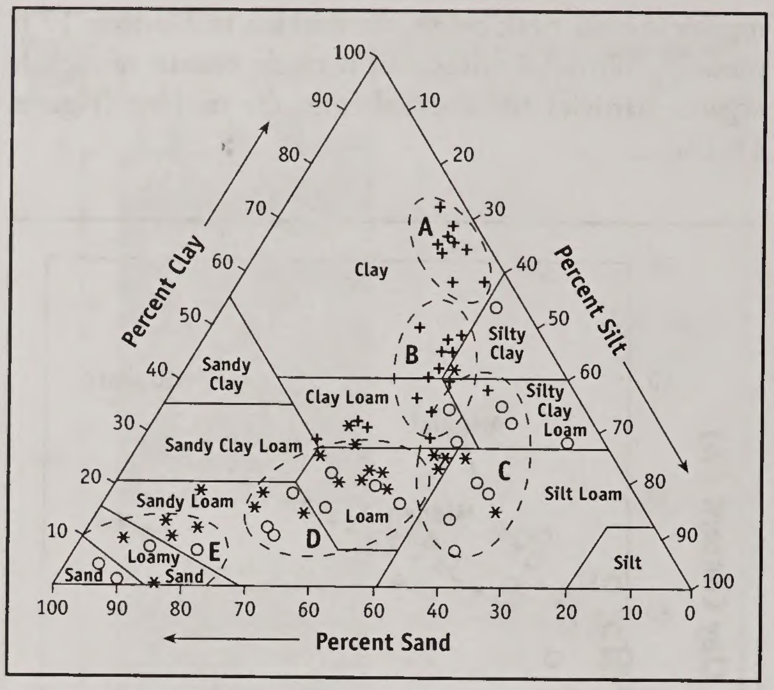



**Figure 13.** Comparison of Holmes Terrace (+) (A,B), Lost Terrace (o)(C,D,E), and Thompson Bottom (*) (C,D,E) sedimentary profile particle-size distributions.

Calcium carbonate-equivalent percentage was measured by a gravimetric technique using a weak acid to dissolve the carbonates. Values, which range from 4 to 13, strongly correlate with texture. A weak positive correlation with clay content which is negatively correlated with sand content. That evidence supports the idea that carbonates were carried by capillary flow in groundwater through fine-textured materials. There is also a slight segregation of horizons below the midden.

Available phosphorus, measured by the Bray No. 2 Method (Gray and Kurtz 1945), positively correlates with organic matter and is essentially absent for horizons with low organic matter. By far the highest phosphorus is seen in the midden, even though organic matter is relatively low. Horizon 15 is clearly an anthropic horizon, as indicated by artifacts. The notion that high phosphorus content is a sign of human activity at archaeological sites (Hetland 1980) is supported strongly at Thompson Bottom.

## Conclusions

The Thompson Bottom site represents the recent prehistoric occupation of a floodplain that had received overbank flood deposits since abandonment. Very low pedogenic stability is suggested by little to no soil formation in any horizon. Regular flood deposition has buried whatever soil development that had started. Chemical properties that could be associated with pedogenesis are those primarily associated with the specific geomorphic setting. Carbonates in the groundwater are the main source of secondary lime deposits. Alluvial organic detritus is a major source of organic matter. Questionable pedogenic organic matter is found in two to three horizons, and probable pedogenic organic matter occurs in only two horizons.

### Geomorphic Relationships

Thompson Bottom is located far away from colluvial influences and was built up only by Missouri River overbank deposition. It is a product of the very recent building of a sediment bar in a straight channel in a position that may have been a point bar that was dissected after abandonment of the meander channel, a scar from which is apparent just downstream from the site (Figure 5). That channel may continue upstream to the north side of a broad terrace (Figure 5). That meander may be a remnant of the original pattern incised in the till plain that can still be seen in the upper edge of the canyon walls (Figure 5). The abandonment of the meander channel north of the site marked the end of downcutting, which was normally in a straight channel, and the beginning of the lateral migration of a maturing stream channel. The Missouri River there appears to be changing from a youthful meander pattern to a more mature, but straight pattern.

## Comparison of Sediments and Sedimentary History of the Thompson Bottom, Lost Terrace, and Holmes Terrace Floodplain Sites

### Mechanical Analysis

The range of textures present in Thompson Bottom and Lost Terrace (Ottersberg 1985) sediments are very similar (Figure 13). Holmes Terrace (Davis et al. 1982) sediments are finer than sediments at the other two sites, partly because sandy sediments near the basal channel gravels were not collected during fieldwork at Holmes Terrace, but were at Lost Terrace and Thompson Bottom. The sandy loams, loamy sands, and sands represent deposition as a channel deposit or as high-velocity channels of floodwaters. The loams, silt loams. and finer deposits are regarded as overbank deposits on the floodplain.

The abundance of clays in Holmes Terrace sediments is related to a variety of factors. Holmes Terrace is farther downstream than the other compared sites. Sediment load in the stretch of the Missouri studied shows a definite decrease in particle size with location progressively downstream (Erdman et al. 1962). Holmes Terrace sediments were also influenced by tributaries such as Arrow Creek

and the Judith River which drain large areas of soft clay-rich sediments. Holmes Terrace is also older than the other two landforms by 600 to 2,000 years. Different climatic conditions can influence general sediment character. A wetter period may have led to greater sediment contributions of clays eroding from stream channels of the Plains. Holmes Terrace has been only slightly influenced by flood deposition in recent times, compared to Lost Terrace and Thompson Bottom which had both experienced significant, very recent floodplain deposition.

The recent floodplain deposits on Holmes Terrace have significantly coarser textures than the lower and older floodplain deposits, a fact that was initially attributed to winter-time ice jam floods (Davis et al. 1982). However, it may be that the coarser sediments reflect a time of flood deposition that correlates with floodplain building at the two sites upstream when the general sediment load of the river was coarser.

Since variations in sediment textures appear to relate to time and distance downstream, some intersite stratigraphic correlation may be possible. Effects of local topography, such as nearness to colluvial or alluvial fan influences, need to be recognized when attempting correlations between alluvial sediments at one site with those of others along the Missouri. Clay mineralogical analysis is a potentially valuable correlation tool that was not used in this study, but which should be applied during future similar studies in order to more strictly identify drainage-basin contributions.

## Chemical Analysis

The chemical parameters of organic-matter, $CaCO_3$ content, and available phosphorus are more alike at Lost Terrace and Thompson Bottom than at Holmes Terrace. Geologic and hydrologic factors are similar at those two sites. At all three sites, influences from soil formation are only weak.

Organic-matter content is low for sediments that have dark colors associated with pedogenic organic accumulations, and it is generally less than 5 percent. Sediments with lighter colors at Holmes Terrace have less than 3 percent organic matter, while Lost Terrace and Thompson Bottom have less than 1.5 percent organic matter. A positive correlation between organic-matter and clay content would explain why Holmes Terrace has slightly more organic matter than the other two sites. Alluvial detritus is a significant source of organic matter in flood deposits (Krumbein and Sloss 1957). Most horizons with pedogenic organic matter do not fit the relationship indicated as between organic matter and clay.

The $CaCO_3$ content of Thompson Bottom and Lost Terrace sediments are very similarly related to the combination of a midden and the watertable. Each has a midden located near the upper limit of a watertable, as is indicated by rust-brown mottles. Above the watertable, $CaCO_3$ levels are significantly lower than below, and especially below the midden. Abundant decomposed bone may be a major source of carbonates there. Holmes Terrace does not have a midden or significant accumulations of $CaCO_3$ in any part of the profile. At all three sites, $CO_3$ content positively correlates with clay content. Decreased particle size increases the capability of water being transported by capillary flow. Movement from groundwater through fine-textured sediments to an evaporating surface could have enriched the zones through which the water moved, transporting soluble salts such as $CaCO_3$. It is also possible that calcareous material was derived from the original alluvial deposit. At Holmes Terrace, colluvial materials do not display the same positive correlation between clay and carbonates; less carbonates are associated with sediments with more clay.

Secondary deposits of lime are not a consequence of pedogenic processes, but are instead affected by parent material source, influence of groundwater, and apparent influence of a midden. Any kind of mineralogical analysis used in attempts to intercorrelate sediments in Missouri River terraces clearly must take these factors into account.

Phosphorus content is abnormally high in middens, which are generally positively correlated with organic-matter content and negatively correlated with $CaCO_3$ content.

Holmes Terrace did not have a midden or the associated abnormal phosphorus levels, but it did have the only definite negative correlation with $CaCO_3$. High clay and the associated higher organic-matter content may have provided enough samples with significant phosphorus to show a relationship. Lost Terrace and Thompson Bottom have too few sediments with significant organic matter or phosphorus to show any relationship to $CaCO_3$. Sediments with apparent pedogenic organic matter also have more phosphorus than the average sediment. The midden at Thompson Bottom had 50 to 100 times more phosphorus than the alluvial sediments, with low organic matter and three to eight times as much as sediments with significant organic matter. Phosphorus was not abnormally high in sediments from zones with known occupations at Holmes Terrace, possibly because sediments were sampled at other than the actual site of occupation, but probably because bone detritus was light and widely scattered.

## Implications of Sediment and Soil Studies for Floodplain Archaeology

Comparisons of sediments and soils exposed by the Missouri River, or by excavation of archaeological sites along the river, may aid in correlating occupations at different sites if the factors associated with sediment deposition are considered carefully in each case. Factors of deposition will affect both physical properties such as grain-size distribution and mineralogical character. Observations about sediments collected at the Holmes Terrace, Lost Terrace, and Thompson Bottom sites relate only to the Missouri River floodplain from Big Sandy to just below the mouth of the Judith River.

Hydrologists have recognized the decreasing particle size of the Missouri River bedload that is evident in the Upper Missouri National Wild and Scenic River research area below Great Falls (Erdman et al. 1962). According to that study, sand and silt are the dominant size classes carried in the bedload above the Judith River. Any gravels and sands below that point and gravels upstream to Big Sandy were derived from local tributaries. In general, particle sizes of sediments is significantly finer at Holmes Terrace than at Lost Terrace and Thompson Bottom. That difference is not attributable only to relative distance downstream, however.

Holmes Terrace is a much older terrace that may have been influenced during a time when the sediment load was affected by climate or sediment source. A wetter, cooler period after the dry Altithermal, or Atlantic, interval may have introduced more clays from prairie tributaries, or possibly from more channel banks deposits. The Cretaceous-age, clay-rich shales lining the Judith River channel may have been a significant influence at Holmes Terrace that did not affect terraces upstream from the mouth of the Judith River. Stabilization of channels during succeeding drier times may have reduced the amount of clay-rich sediments derived from prairie tributaries, which had contributed to the formation of the Lost Terrace and Thompson Bottom terraces.

Particle-size distribution varies greatly within a terrace, depending on stage of terrace formation. A generalized terrace goes through a sequence of gradually decreasing size of deposits as river velocity changes from fast channel to slower floodplain deposits (Reineck and Singh 1980). That sequence is not regular or always repeated, but it is represented by a distinctive morphology; that is an important way to identify type and stage of deposit. Lost Terrace contains "channel gravels" in a fine-textured zone of sediments that would normally be regarded as overbank or slow-water flood deposits. But wintertime ice-jam flooding could also explain that anomalous textural sequence. Since patterns of texture are not constant, it is necessary to identify all possible sources of variation. Other sources of particle-size variation include effects of local stream dynamics. Position along a bend or in relation to a local tributary can affect the size of sediment in the bedload. A braided, straight, or meandering channel pattern will affect type and morphology of sediment deposition (Reineck and Singh 1980). Distance from the canyon walls to the terrace affects the potential for colluvial and alluvial fan deposition.

Many of the factors that affect particle size also affect mineralogy. Source areas change with distance downstream. The age of a terrace may also reflect change in source areas that is attributable to climatic and environmental fluctuations. Annual climatic variation appears to have had an influence on mineralogy at Holmes Terrace that was evident in morphological differences between "winter" and "summer" flood deposits. The velocity of water at one point of a terrace may be greater in winter due to higher water stages attained when ice-jamming dams the river (Erdman et al.1962). Cold temperatures increase the viscosity and thereby the size of sediments carried (Crumbein and Sloss 1956). The effects of local colluvial sources on mineralogy were significant at Holmes Terrace, but less so at the other two sites because of their greater distance from impinging canyon walls.

Any attempt to correlate terraces with sediment type or age of deposition must first account for the age of the deposit, position of sediments within the terrace, position of the site in relation to local stream dynamics, distance of the site from local colluvial sources, and distance downstream along the main channel. Gross particle-size distribution (sand, silt, and clay content) and indirect measures of sediment type such as color are used in this study for comparative purposes. More refined techniques such as statistical gradational analysis and clay mineralogy would yield a clearer view of sediment differences. Statistical analyses such as kurtosis or skewedness, median grain size, logarithmic plots of the coarsest percentile grain size, roundness, sphericity, and heavy mineral content are parameters that have been used elsewhere effectively to characterize and differentiate alluvial sediments (e.g., Bull 1962; Folk and Ward 1957; Headily 1960). Clay mineralogy may be particularly useful in identifying sediment source areas.

# Stratigraphy and Excavation

*Leslie B. Davis*

Cultural strata at site 24CH452 extend for 115 m (west to east) along the floodplain. Two separate areas (A and B) (Figure 14) were selected for excavation in order to sample the deposits along a line roughly parallel with the present cutbank. A surface area of 21 m$^2$ was stripped by a backhoe at A, and 14 m$^2$ at B. More than 40 m$^3$ were removed by the backhoe and 5 m$^3$ were removed by trowel and power-screen at A (Figure 14). Only 20 m$^3$ were removed by backhoe and less than 1 m$^3$ was troweled in B. A surface area of nearly 17 m$^2$ was excavated by hand at A, with 4 m$^2$ at B.

Area B encloses three buried occupation layers. The most recent (Occupation Zone 1) was sacrificed by mechanical earthmoving to expose Occupation Zone 2. Limited excavations there exposed one charcoal and rock-filled hearth around which butchered bison remains were scattered.

The abundance of cultural material found in Area A, Occupation Zone 3, led to the concentration of excavation effort (Figure 8). The three cultural strata evident at Area B correlate with three strata noted in Area A.

Excavation Area A (Figure 14) was selected as a consequence of abundant features and mammal remains evident in the cutbank collection. It appeared at the outset of exploration at Thompson Bottom that four discrete cultural zones were contained in the river alluvium there. Because the two uppermost occupation zones were thin and contained only widely scattered, shallow features and little bone, Occupation Zones 1 and 2 were sacrificed. Occupation Zone 3 was sampled carefully. Following the completion of excavation of Occupation Zone 3 in Area A, auger holes were powered through into the underlying river gravels; the possible presence of a deep fourth cultural layer was ruled out.

Occupation Zone 3 is a clearly defined, undisturbed cultural surface (Figure 8) that served as a food, hide, and stone-processing station (Figure 15). Because of the dominant presence of butchered bison, this site may have been the bison-processing location associated with the drive lines (and lanes) evident to the southwest at site 24CH81 (Figure 14).

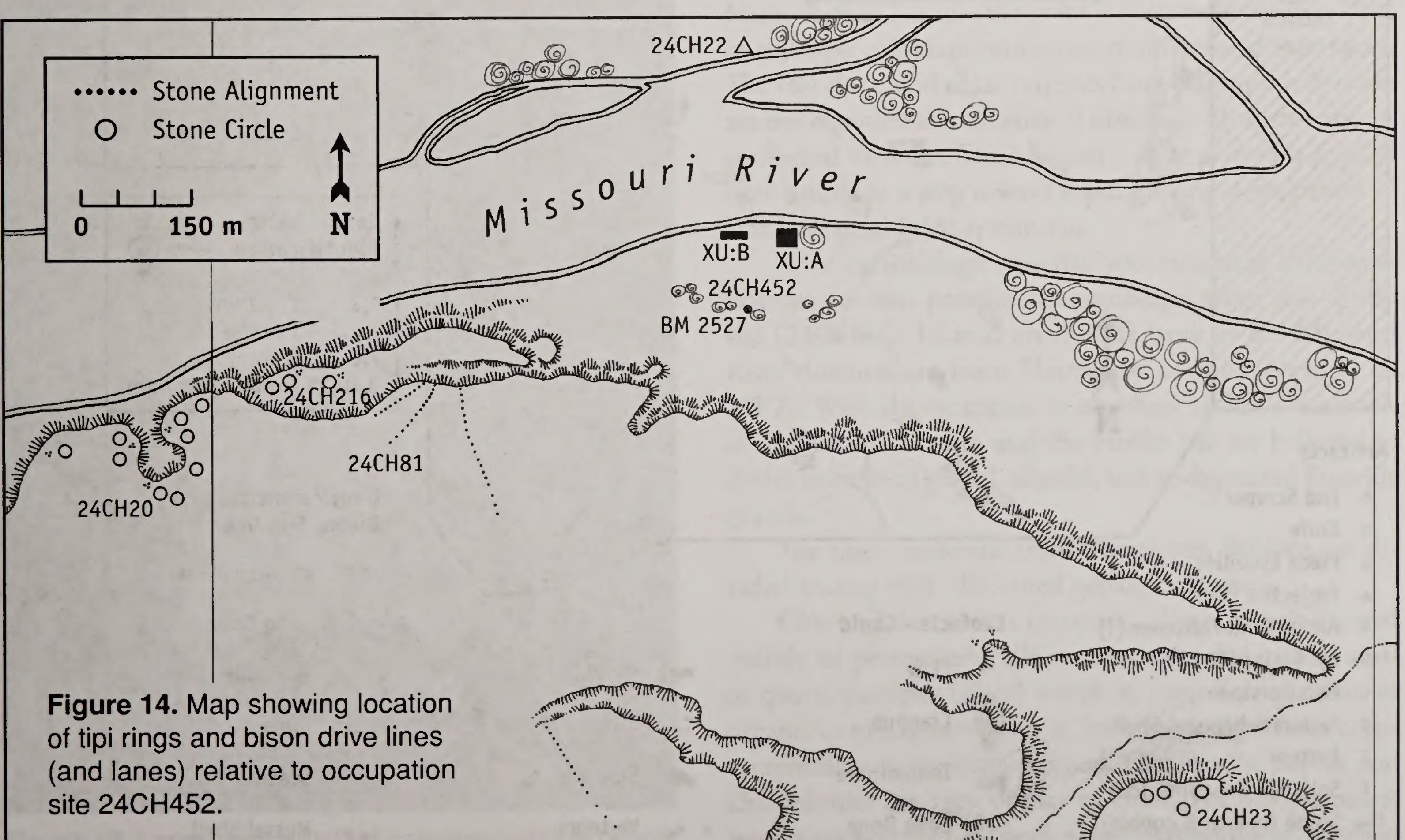



Figure 14. Map showing location of tipi rings and bison drive lines (and lanes) relative to occupation site 24CH452.

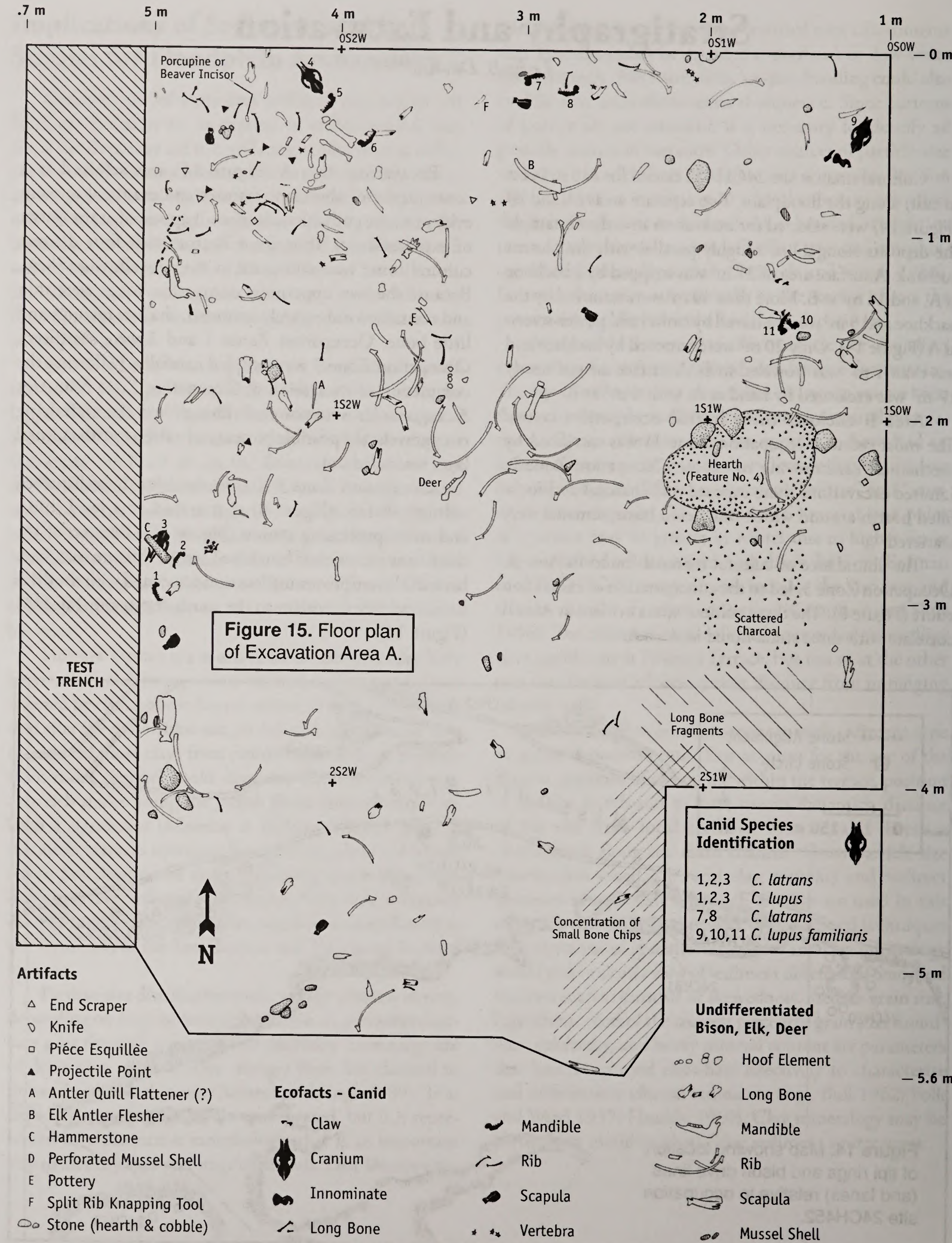



**Figure 15.** Floor plan of Excavation Area A.

# Material Culture

*Stephen A. Aaberg*

The Thompson Bottom material culture sample includes flaked stone, battered stone, bone, and shell artifacts, and earthenware ceramics. Forty-seven complete and fragmentary flaked stone artifacts, three pecked stone artifacts, bone and shell artifacts, and 28 potsherds comprise the site assemblage described and analyzed below.

## Flaked Stone

### Introduction

Eleven side-notched projectile points, one side-notched chalcedony ceremonial trade point (Figure 16), four unclassifiable point fragments, six bifaces and fragments, eight end scrapers, five pièce esquillées, 12 modified flakes, and 2,685 waste flakes constitute the flaked stone subassemblage. Cores are absent and only a few shatter fragments are present.

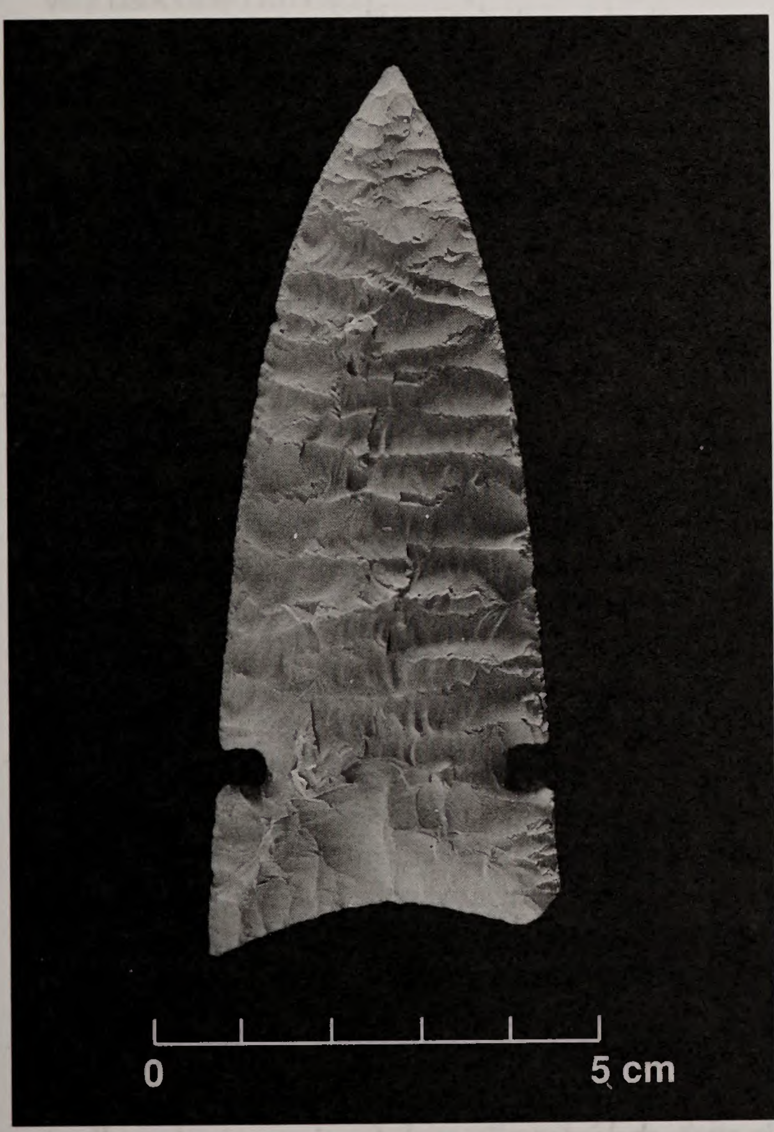



**Figure 16.** Large, side-notched ceremonial/trade biface.

Formal and functional characterizations for flaked stone specimens are presented below. Descriptions include lithic material categorization based on macroscopic and microscopic examination. Munsell color coding was applied as a descriptive standard to chert, chalcedony, siltstone, porcellanite, quartzite, silicified wood, and dacite specimens; some color varieties present in the site assemblage could not be characterized using the Munsell charts for the northern latitudes. Morphological and technological observations are also noted. Tools and flakes which retain edges sufficient for use-wear analysis were examined under a binocular microscope at 10.5 to 41.5X magnifications.

### Lithology

Ninety-four distinguishable color varieties were defined by the application of the Munsell system to lithic specimens. Ten color varieties could not be characterized on the Munsell chart because the color is not present in the charts or no single color is dominant on multi-colored specimens. The 104 discerned color varieties from Thompson Bottom are not regarded as indicative of lithologically distinctive or geological varieties. The Munsell coding system is applied here simply as a step toward standardizing descriptions of archaeological lithic specimens.

All of the lithologic material types present at Thompson Bottom are also present in assemblages from the Hoffer site (24CH66), located on the left bank of the Missouri River downstream from Thompson Bottom (Davis et al. 1982). With the exception of obsidian, all lithic materials at Thompson Bottom and the Hoffer site are believed to derive from local glacial, alluvial, and re-deposited Flaxville gravels.

The lithic materials from Thompson Bottom are divided among eight discerned geologic classes:

**Chert** (Table 1) is a compact, siliceous rock formed mainly of petrographically microscopic chalcedony and/or quartz particles (silica) which is, regardless of color, of organic or precipitated origin. Structure ranges from cryptocrystalline to medium-grained. Genetically, jaspers and chalcedonies are very similar to chert. For our purposes, jaspers are regarded as chert, while chalcedony is classified

**Table 1.** Chert Color Varieties.

**BROWN**

- Yellowish Brown (10YR5/4, 5/6, 5/8)
  - banded with black speckles
- Grayish Brown (2.5Y5/2; 10YR5/2)
  - mottled with dark grayish brown,black, and white
  - mottled with pale brown
- Very Dark Brown (10YR2/2)
  - mottled with dark yellowish brown
- Dark Brown (10YR3/3; 7.5YR3/2)
  - mottled with black with dark specklesDark Yellowish
- Brown (10YR4/4, 4/6, 3.4)
  - with dark mottling with black speckles mottled with
- reddish brown, brownish yellow Light Yellowish Brown (10YR6/4)
- Brown (10YR5/3; 7.5YR4/4, 5/4)
  - with red inclusions mottled with pink
- Pale Brown (10YR6/3)
- Dark Grayish Brown (2.5Y4/2; 10YR4.2)
  - with black mottling, banding, and speckles mottled and banded with olive brown and brown
- Very Dark Grayish Brown (10YR3/2) banded
- Very Pale Brown (10YR7/3)
  - mottled with pale brown and grayish brown
- Brownish Yellow (10YR6/6)
  - mottled tan, brown, reddish brown, white (No Munsell)

**GRAY**

- Very Dark Gray (10YR3/1), 5/1; 2.5Y3/0)
  - banded with dark gray
- Dark Gray (5Y4/1; 10YR4/1; 7.5YR4/0)
  - mottled with light gray and white mottled with black
- Light Gray (10YR7/1; 7.5YR4/0)
  - mottled with light gray and white mottled with black
- Light Gray (10YR7/1; 2.5Y7/0)
  - streaked with yellow with white inclusions
  - mottled with gray
- Reddish Gray (10R6/1)
- Light Brownish Gray (2.5Y6/2)
  - mottled with light gray
- Pinkish Gray (5YR7/2; 7.5YR7/2)
  - with white inclusions
- Gray (10YR6/1)
  - mottled with dark gray

**RED**

- Dusky Red (10R3/3; 2.5YR3/2)
  - mottled with dark yellowish brown
- Very Dusky Red (10R2.5/2; 2.5YR2.5/2)
- Weak Red (2.5YR4/2)
- Reddish Yellow (7.5YR6/8)
- Yellowish Red (5YR4/6, 6/6)
  - mottled with yellow

**WHITE**

- White (10YR8/1, 8/2)
  - with white inclusions mottled whites

**BLACK**

- Black (10YR2/1)
  - mottled with dark yellowish brown mottled with white and dark brown

separately. The dominant color variety and the largest number of cherts are browns, while grey cherts are also quite common. Red, black, and white cherts occur less frequently. Irregular mottling, speckling, and banding are common in many of the cherts. Luster ranges from dull to vitreous. Potlid fractures are rare. Evidence of heat-treatment of cherts such as color changes and vitreous luster is generally lacking.

**Chalcedony** (Table 2) is composed of silicates and has much the same genesis as chert. However, compositional particles in cherts overlap as the rock develops, whereas chalcedony develops as particles that loop together and do not overlap extensively. Thus, chalcedony has a characteristic fibrous appearance and translucency. Chalcedony is the base material of agate; therefore, specimens of agate are categorized with chalcedony. The most common colors represented among chalcedony specimens are browns and translucent to subtranslucent whites. Greys, reds, and greens occur less frequently. Mottling and banding are evident in some specimens, and inclusions are also apparent in some chalcedony specimens.

**Quartzite** (Table 3) consists primarily of quartz particles which comprise a solid, opaque rock created through metamorphic alteration or through the cementation of sandstone by replacement of sediment with silica. Quartzite displays considerable variability in color and granularity. A distinctive medium-green quartzite is the most common color variety. No other green quartzites are present. Browns, grays, and whites are also represented. All quartzites are fine-grained.

**Porcellanite** (Table 4), a siliceous rock, is similar in appearance and granularity to some fine-grained siltstones. However, porcellanite derives from thermal alteration of shales and clay by coal burns. Generally, its texture is finer than siltstone and its luster, hardness, and appearance are similar to that of unglazed porcelain. A sub-variety of porcellanite, vitreous porcellanite, is absent. Grays and reds are the color varieties present.

**Silicified Wood** (Table 5) was formed by replacement of wood by silica in such a way that the original form of the replaced wood is preserved. The replacement material is often chalcedony or opal. Specimens in the collection

**Table 2.** Chalcedony Color Varieties.

**BROWN**
- Strong Brown (7.5YR5/6)
- Dark Brown (7.5YR3/2)
- Yellowish Brown (10YR5.4)
  - mottled with red

Dark Reddish Brown (5YR3/2, 3/3)
Brown (7.5YR4/2; 10YR5/3)
- banded
- Grayish Brown (10YR5/2)
- Dark Grayish Brown (10YR3/2, 4/2)
- Dark Yellowish Brown (10YR3/6, 4/4)
  - mottled with brown
- Light Yellowish Brown (10YR36/4)
- Light Reddish Brown (2.5YR6/4; 5YR6/3)
- Reddish Brown (2.5YR5/4)
- Yellow (10YR7/6)
- Brownish Yellow (10YR6/6)
- Very Dark Brown (10YR2/2)

**GRAY**
- Light Gray (10YR7/3)
  - with white inclusions
- Dark Gray (5Y4/1)
- Very Dark Gray (10YR3/1)
- Light Brownish Gray (2.5Y6/2)

**RED**
- Pink (5YR7/3)
  - with red speckles
- Pale Red (10R6/4)

**GREEN**
- Greenish Blue (No Munsell)
- Green (No Munsell)

**TRANSLUCENT TO SUBTRANSLUCENT**
- Milky (No Munsell)
- Clear
- Subtranslucent tinged with yellow
- Subtranslucent tinged with pink
- Subtranslucent tinged with brown

that are banded take the form of the wood grain, and they include browns and grays.

**Dacite** (Table 6) very generally refers to any dark, fine-grained igneous rock. Specifically, it is an extrusive composed primarily of calcic plagioclase and pyroxene which may or may not contain olivine. Granularity varies from very fine-grained to coarse-grained. The most common color is black, although some very dark green and brown varieties are known. Dacite from the site is black to very dark gray.

**Siltstone** (Table 7) consists of generally fine-grained consolidated clastic rock composed predominantly of silt-

**Table 3.** Quartzite Color Varieties.

**BROWN**
- Pale Brown (10YR6/3)
- Light Reddish Brown (5YR6/4)
- Light Yellowish Brown (10YR6/4)
- Reddish Brown (2.5YR5/4)

**GRAY**
- Very Dark Gray (2.5Y3/0)
- Pinkish Gray (7.5YR7/2)
- Light Gray (10YR7/1)
- Light Brownish Gray (10YR6/2)
- Dark Gray (5YR4/1)

**WHITE**
- White (10YR8.1)

**GREEN**
- Medium Green (No Munsell)

**Table 4.** Porcellanite Color Varieties.

**GRAY**
- Light Gray (2.5Y7/0; 5Y7/1)
- Gray (2.5Y5/0; 6/0)
- Dark Reddish Gray (5YR4/2)

**RED**
- Dark Reddish Brown (5YR2.5/2; 5YR3/2)
- Dusky Red (10R3/2)

**Table 5.** Silicified Wood Color Varieties.

**BROWN**
- Yellowish Brown (10YR5/6)
- Dark Brown (7.5YR3/2)
- Very Dark Brown (10YR2/2)

**GRAY**
- Gray (10YR7.1)

**Table 6.** Dacite Color Varieties.

**BLACK**
- Very Dark Gray (2.5Y3/0)
- Black (7.5YR2/0)

**Table 7.** Siltstone Color Varieties.

**GRAY**
Light Gray (10YR7.1)
salt-and-pepper particle inclusions

grade particles. Consolidation derives from cementation by silica. A distinctive light gray siltstone with more coarse black and white particles is the only variety present. Bedding planes in these clastic rocks often inhibit conchoidal fracturing.

**Obsidian,** a volcanic glass, normally has a glassy luster and fractures conchoidally. Imported obsidian is rhyolitic in composition. Obsidian from Thompson Bottom is black and ranges from opaque to translucent depending upon flake thickness.

## Tools

Formal and functional characteristics for all tools, including morphological attributes, indications of use wear, and lithic class, follow below:

**Side-Notched Bifaces/Projectile Points** (Table 8). Eleven complete and fragmentary side-notched bifacial

**Table 8.** Side-Notched Bifaces/Projectile Points: Formal Attributes.

| Specimen Number | Condition | Dimensions TL | SL | BW | SW | NW | T | Lithic Material | Blade Shape | Base Shape | Basal Grinding |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 97 | complete-original | 35.6 | 6.3 | 16.3 | 14.9 | 9.2 | 3.3 | reddish-gray chert (10YR6/1) | triangular | straight | no |
| 87 | complete-original | 27.5 | 8.5 | 15.1 | 14.8 | 11.0 | 3.3 | white chert with white inclusions (10YR8/1) | triangular | straight | no |
| 84 | proximal-half | - | 6.6 | 15.1 | 14.8 | 8.6 | 2.9 | dark reddish-brown chalcedony (5YR3/2) | triangular concave | slightly | no |
| 9 | proximal-half | - | 8.4 | 15.4 | - | 10.3 | 3.1 | dusky red porcellanite (10R3/2) | triangular | concave with basal notch | no |
| 6 | base-original | - | 9.9 | - | 17.5 | 9.6 | - | white chert (10YR8/1) | - | slightly concave | no |
| 5 | base- | - | - | - | 14.4 | 8.6 | - | light gray procellanite (5Y7/1) | - | straight | no |
| 88 | edge/basal fragment-reworked | - | 7.7 | - | - | - | - | yellowish-brown chalcedony with dark inclusions (10YR5/4) | triangular | straight | no |
| 2 | base-original | - | - | - | 14.7 | 8.9 | - | white chert (10YR8/1) | - | straight | no |
| 83 | base-original | - | - | - | 16,1 | 9.6 | - | black obsidian | - | concave | no |
| 136 | basal fragment original | - | - | - | - | - | - | black obsidian | - | straight | no |
| 181 | complete-original | 77.9 | 17.8 | 28.7 | 31.4 | 21.1 | 5.9 | light gray chalcedony (2.5Y7/0) | triangular | concave | no |

tools were recovered, five of which are sufficiently complete to allow use-wear analysis. Three of those specimens display sharp, crisp edges indicative of exclusive use as projectile points. Two other specimens bear signs of secondary use for cutting (Table 9).

side-notched points with basal notches and side-notched points is well documented (cf. Davis and Zeier 1978; Frison 1967a, 1970a,b). Both point types are attributed to the Late Precontact Period (ca. A.D. 200-1,700); however, basal-notching apparently associates with that interval just

**Table 9.** Side-Notched Bifaces/Projectile Points: Functional Attributes.

| Specimen Number | Use Wear | Suggested Uses |
|---|---|---|
| 97 | None; crisp, clean edges | projectile point |
| 87 | Slight crushing of projectiles and moderate step-fracturing | projectile point and cutting tool |
| 84 | None; crisp clean, edges | projectile point |
| 9 | None; crisp, clean, edges | projectile point |
| 88 | Crushing of projections, step-fractures, and slight polish | projectile point and cutting tool |
| 181 | None; crisp, clean, edges | notched ceremonial or trade biface |

Flaking quality on the side-notched specimens ranges from very fine to good. Dimensional attributes are relatively uniform, with limited variation. One notable exception is Specimen 181 (Figure 16). This finely flaked artifact is more than twice the size of the rest of the projectile points. Its edges are very sharp and use wear is absent. Presumably, the size of this specimen precluded its use as an arrow point. Morphological characteristics are identical to most of the other projectile points in the assemblage. Its size, symmetry, and the quality of flaking distinguish it from the rest of the projectile point shapes. The attention given this anomalous artifact may be an effect of production for special ceremonial, ritual, other non-utilitarian use, or trade.

Interestingly, Aaberg observed and photographed a number of closely similar, large, side-notched artifacts in State Historical Society of North Dakota collections from the Mandan-associated On-A-Slant Village (32MO26). One fragmentary, large side-notched biface recovered from later excavations at Slant Village is thought to represent a lance tip or ceremonial staff tip similar to that depicted in Karl Bodmer's painting of a Mandan leader (Ahler 1997:322).

Another specimen from the collection of projectile points (Figure 17) exhibits a trait unique in the assemblage. Specimen 9 (Figure 17a) has a basal notch, but is otherwise similar to the other points. The co-occurrence of before the initiation of historic events (Davis and Zeier 1978; Frison et al. 1978).

All classifiable points recovered from the site are Old Women's Phase arrowpoints, as defined by Reeves (1969) from Forbis (1962) and Kehoe (1966, 1967, 1973). The archetype for these arrow points is a small, triangular biface formed by pressure-flaking, with narrow, but deep side-notches placed well up from the base. Bases range from straight to concave and are unnotched or notched.

**Unnotched Bifaces/Knives** (Table 10) (Figure 18a-c). One complete and five fragmentary bifacially worked specimens fashioned on relatively thick flakes are present. All specimens display some use wear indicative of use as cutting implements (Table 11). The one complete artifact is lanceolate with one straight edge and one convex edge (Figure 18b). Both edges of this reworked tool display indications of heavy use for cutting. The remaining fragmentary specimens also present crushed and smoothed edges resulting from use as knives.

These bifaces are finished tools to which final trim was added. Three of the fragmentary specimens had been reworked and, in their final form, are much smaller than the complete specimen. Shapes of the fragmentary specimens could not be firmly established; however, the straight converging edges of three distal fragments suggest triangular to sub-triangular shapes.

**Table 10.** Unnotched Bifaces/Knives: Formal Attributes.

| Specimen Number | Condition | Dimensions L | W | T | Lithic Material | Blade Shape |
|---|---|---|---|---|---|---|
| 1 | complete | 110.7 | 29.2 | 11.5 | yellowish-brown chert with black dendritic inclusions (10YR5/6) | one edge straight, one edge convex |
| 8 | distal end reworked | | | | dark brown chalcedony (7.5YR3/2) | straight to irregular |
| 3 | distal end reworked | | | | very dark gray banded chert (10YR3/1) | convex |
| 7 | distal end original | | | | very dark gray dacite (2.5Y3/0) | convex |
| 85 | end fragment reworked | | | | brown chalcedony (7.5YR4/2) | convex |
| 99 | midsection fragment reworked | | | | very dark gray chalcedony (10YR3/1) | straight |

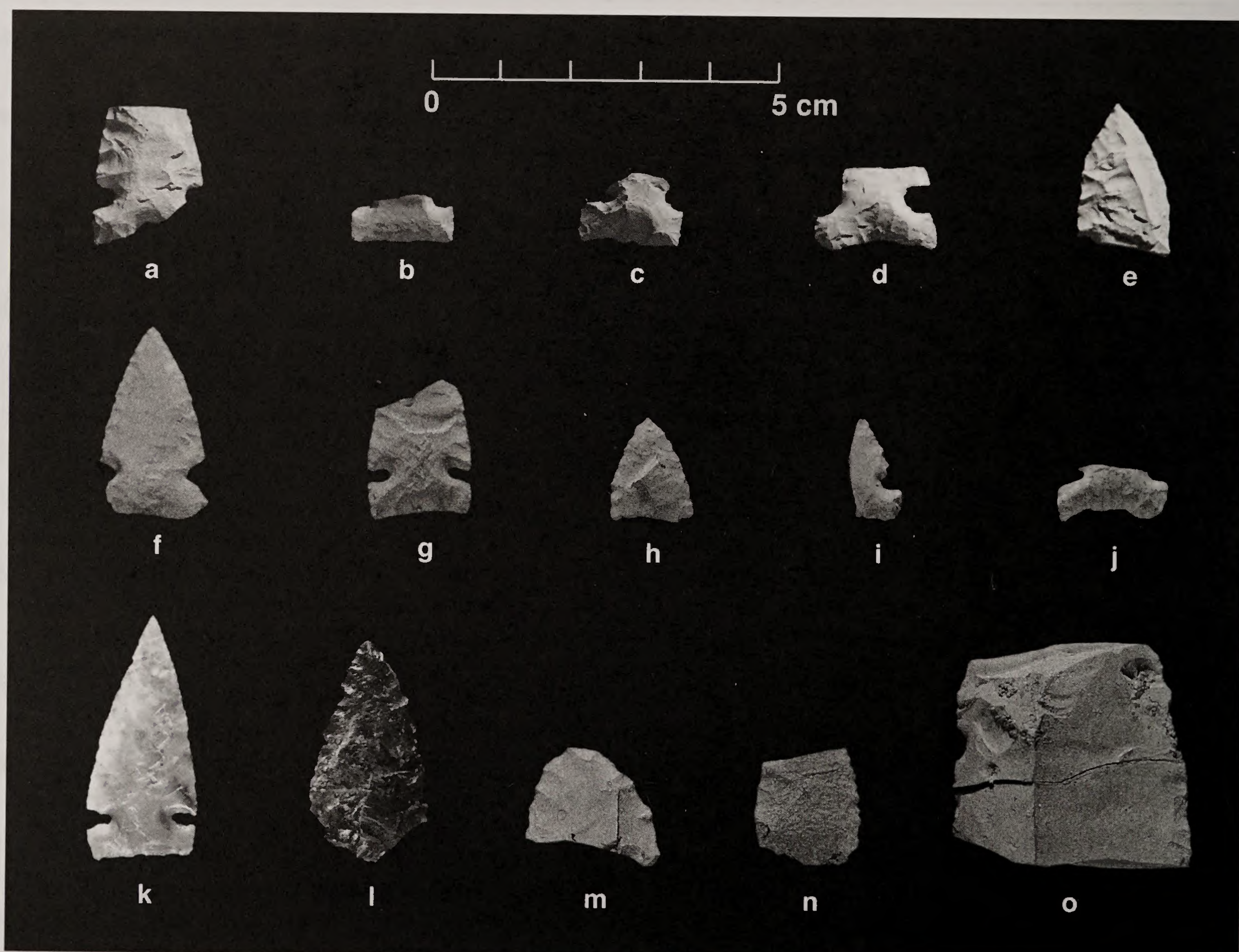



**Figure 17.** Side-notched and triangular unnotched bifaces/projectile points (a-l) and side scrapers (m-o).

**Table 11.** Unnotched Bifaces/Knives: Functional Attributes.

| Specimen Number | Use Wear | Suggested Uses |
|---|---|---|
| 1 | Heavy crushing, smoothing, and step-fracturing on one edge; moderate wear on the other | cutting tool |
| 3 | Crushing of projections and slight polish | cutting tool |
| 8 | Very slight smoothing | cutting tool |
| 7 | Step-fractures and slight smoothing | cutting tool |
| 85 | Crushing, smoothing, and step-fractures | cutting tool |
| 99 | Slight step-fracturing | cutting tool |

## Utilitarian

**Unifaces/End Scrapers** (Table 12) (Figure 18) Eight complete end scrapers were recovered. All specimens exhibit the typical traits of end scrapers: a distal working end with steep-angle, unifacial retouch extending often around the entire tool margin, fashioned on a secondary reduction flake, with a bulb of percussion (sometimes thinned) preserved on the proximal ventral surface which is concave or flat (Figure 18a-g). The specimens vary in size, shape, and degree of wear (Table 12).

**Table 12.** End Scrapers: Formal Attributes.

| Specimen Number | Condition | Dimensions L | W | T | Lithic Material | Body Shape |
|---|---|---|---|---|---|---|
| 18 | complete-original | 38.5 | 26.6 | 7.3 | mottled dark gray/light gray/white chert (5Y4/1.7/1.8/1) | sub-triangular |
| 11 | complete-original | 24.1 | 18.1 | 4.1 | subtranslucent tinged with brown chalcedony | sub-triangular |
| 16 | complete-original | 26.4 | 12.3 | 3.3 | subtranslucent tinged with yellow chalcedony | elongate |
| 17 | complete-original | 26.9 | 25.1 | 8.1 | yellowish-brown banded chert with black speckles (10YR5/4) | sub-rectangular |
| 13 | complete-reworked | 25.4 | 26.6 | 9.4 | yellowish-brown chert (10YR5/6) | sub-rectangular |
| 14 | complete-reworked | 24.6 | 25.3 | 5.9 | very dark gray chalcedony (irregular) | irregular |
| 12 | complete-original | 29.3 | 27.8 | 8.2 | mottled grayish-brown chert (2.5Y5/2) | irregular |
| 77 | complete-original | 36.1 | 42.9 | 6.1 | very dark brown chert (10YR2/2) | irregular |

All working edges are intact. Use-wear analysis on the steeply angled edge revealed crushing and multiple step-fracturing indicative of scraping use. Examination of lateral edges revealed no evidence of use or hafting.

Two specimens are sub-triangular, one is elongate, two are sub-rectangular, and three are irregular in shape.

**Pièce Esquillées** *(Bifacial Wedges)* (Figure 18h-o and Table 13) Pièce esquillées are artifacts that only recently have been recognized in northern Montana (see this volume for others). These tools, which may have served as wedges, were formed on thick core flakes. They are most often rectangular to sub-rectangular in shape. Shaping was accomplished by removing several thinning flakes bifacially from one end of the thick flake. Bifacial-thinning gives the distal working edge its characteristic wedge shape. Pressure-retouch or finishing trim are absent. Platform-preparation is evident on the distal end of all specimens from Thompson Bottom. Platform-preparation presumably was necessary to facilitate the removal of the relatively thick thinning flakes.


**Figure 18.** Unifaces/end scrapers (a-g) and pièce esquillées/bifacial wedges (h-o).

**Table 13.** Pièce Esquillées: Formal Attributes.

| Specimen Number | Condition | Dimensions L | W | T | Lithic Material | Body Shape |
|---|---|---|---|---|---|---|
| 23 | complete-original | 34.4 | 27.1 | 11.8 | mottled dusky red/dark yellowish-brown chert (10R3/3. 10YR4/6) | sub-rectangular |
| 22 | complete-original | 26.1 | 20.6 | 7.8 | yellowish-brown chalcedony (10YR6/5) | sub-rectangular |
| 25 | complete-original | 21.4 | 19.7 | 10.2 | dark gray chert (10YR4/1) | sub-rectangular |
| 24 | distal end-original | | 24.9 | 9.8 | yellowish-brown silicified wood (10YR5/6) | |
| 26 | split laterally-original | 33.7 | | 10.6 | dark brown silicified wood (7.5YR3/2) | sub-rectangular |

These artifacts were likely used for splitting bone and/or other durable organic raw materials (MacDonald 1968). Microscopic examination of the distal end of five specimens revealed extensive crushing of projections and extensive step-fracturing. Driving these wedges into relatively hard material such as bone and wood could have produced such use wear. Three specimens are incomplete. One had been split laterally in half, while two had been fractured at their proximal end. That sort of breakage could easily occur during use, particularly if percussive force had been applied to the proximal end in efforts to drive the wedge into a hard substance.

We are tempted to suggest that the five Thompson Bottom pièce esquillées were utilized in the production of beads made from canid foot bones (Smith and Fisher, this volume), given the reduction involved in severing those bones. However, it appears that the girdling of those bones by cutting with formed knives or sharp flakes was the predominant bone-reduction process, with the exception of bison carcass and bone-reduction. The low incidence of inferred cutting implements seems not to support that deduction, but does not nevertheless suggest a task-specific use for the pièce esquillées found in situ at Thompson Bottom.

Pièce esquillées were recovered surficially from sites 24VL254 (n=9) and 24VL266 (n=1) in the Brazil/Little Beaver Creeks archaeological area surveyed in southwest Valley County, Montana in 1976 (Davis and Aaberg 1976: Fig. 23) (this volume) (Figure 23). Site 24VL254 is a habitation site with associated tipi rings and a nearby drivelane formed by spaced, consecutive stone piles. Time-diagnostic artifacts were absent. Site 24VL266 is also a habitation site identified by tipi rings, which lacked diagnostic artifacts.

Pièce esquillées from a number of sites in the Canadian Rockies and Alberta are associated with the Middle Precontact period (Besant) and with the Late Precontact period (Avonlea and Old Women's phases) (e.g., Reeves 1972, 1974, 1983; Quigg 1974; Calder 1975; L. Brumley 1975; Brumley 1973, 1975, 1976; Rogers 1975).

The somewhat similar, patterned bipolar crushing of size-selected pebbles was noted at Lost Terrace (24CH68), a Late Precontact pronghorn antelope carcass-processing station located downriver, along the floodplain opposite Thompson Bottom (Davis 1976:44-53; Davis and Aaberg 1978:20-23,46-47,54-62; Davis and Fisher 1988, 1990; Davis et al. 2000; Greiser 1988) (Figure 6). The formation of this Avonlea phase food and hide-processing midden involved the systematic reduction of nearly 90 adult and subadult pronghorn carcasses (Davis et al. 2000). The few hafted cobble hammerstones in the artifact sample seem insufficient in number for that task. However, neither the function, nor functions, of the relatively numerous modified pebbles were readily inferred at Lost Terrace.

**Edge-Modified Flakes** (Table 14). Of the 12 edge-modified flakes, four are bifacially modified, while the remaining eight had been unifacially worked.

The bifacial specimens show edge wear, although the degree of such wear varies. One specimen had been fashioned from a blade, while another had been made on a large cortical flake. The other two bifacial tools are incomplete.

The eight unifacially modified flakes had been formed

**Table 14.** Edge-Modified Flakes: Formal and Functional Attributes.

| Specimen Number | Condition | Dimensions L | W | T | Lithic Material | Working Edge Shape | Comments/ Use Wear |
|---|---|---|---|---|---|---|---|
| 33 | bifacially worked on one edge | 63.8 | 42.9 | 25.2 | mottled grayish-brown/pale brown chert (10YR5/2) | convex | Some crushing and step-fractures evident, but heavy use is not indicated. |
| 19 | bifacially worked on one edge | 34.5 | 19.9 | 3.9 | dacite (7.5YR2/0) | straight | Moderate crushing and step-fractures evident. |
| 94 | bifacially worked on one edge | | 14.6 | 2.2 | dacite (7.5YR2/0) | convex | Moderate crushing of projections and step-fractures. |
| 20 | bifacially worked on one edge | 34.1 | 14.1 | 5.5 | light gray chert streaked with yellow (10YR7/1) | straight | Heavy step-fracturing and crushing of projections. |
| 96 | unifacially worked along two edges | 32.7 | 33.5 | 10.6 | mottled light gray/gray chert (2.5Y7/0, 5/0) | straight | Little step-fracturing or crushing. |
| 75 | unifacially worked along one edge | 27.7 | 13.8 | 3.3 | yellowish-brown chert (10YR5/6) | straight | Little step-fracturing or crushing. |
| 78 | unifacially worked along one edge | | | | mottled dark brown/black chert (10YR3/3) | straight | Crushing of projections and step-fractures |
| 76 | unifacially worked along one edge | 29.8 | 19.2 | 8.2 | yellowish-brown chert (10YR5/6) | convex | Heavy step-fracturing and crushing of projections. |
| 15 | unifacially worked along one edge | 34.3 | 17.1 | 4.2 | white chert with a few dark inclusions (10YR8/2) | slightly convex | Heavy step-fracturing and crushing of projections. |
| 79 | unifacially worked along one edge | 37.3 | 12.3 | 3.9 | dacite (7.5YR2/0) | irregular | Some crushing and step-fractures. |
| 21 | unifacially worked along one edge | 30.9 | 25.8 | 3.6 | medium green quartzite (No Munsell) | straight | Heavy step-fracturing and crushing of projections. |
| 101 | unifacially worked around entire margin | 97.9 | 97.6 | 21.3 | light yellowish-brown quartzite (10YR6/4) | convex | Moderate crushing and step-fracturing evident along three edges. |

on flakes of various shapes: two blade-like flakes; one triangular flake; and three irregularly shaped flakes.

Edge wear on the unifacial specimens ranges from light to heavy.

**Lithic Debitage**

Debris residue from the production and maintenance of stone tools consists of 2,676 flakes and nine shatter fragments. Eight lithic types are present in the debitage: chert, chalcedony, quartzite, porcellanite, silicified wood, dacite, siltstone, and obsidian. Chert accounts for 28.6 percent of site lithics, chalcedony for 21.6 percent, obsidian 19.9 percent, dacite 17.2 percent, quartzite 6.6 percent, siltstone 3.7 percent, porcellanite 2.1 percent, and silicified wood .3 percent of the total.

No prepared cores are evident in the site assemblage, and only .2 percent of the flakes are primary reduction flakes, based on a definition by Greiser (1983). The absence of cores and primary reduction flakes may reflect technological activities at Thompson Bottom.

Ninety-five percent of all the primary reduction flakes reflect removal of cortex from small, rounded pebbles, which are either glacial or stream bed in origin. Very few thinning and reduction flakes are larger than 15 mm in diameter. The gravels in the area contain most of the lithic resources utilized at Thompson Bottom. Siltstone, porcellanite, and obsidian were imported, however.

Scarcity of sources of primary lithic material in the area likely required more efficient use of what resources were available as pebbles. A specialized reduction technology may have been necessary to efficiently utilize such pebbles. Flakes are categorized by reduction technique and stage of reduction by lithic material (Table 15). Flake categories follow Greiser (1983): finishing, thinning, and shaping flakes.

The first category (Group I) includes finishing and re-sharpening flakes that are generally under 15 mm in length and width and less than 2 mm thick, which were formed by pressure-flaking. The overwhelming majority of the total (84%) falls in this group. This large percentage holds through all of the lithic types except for silicified wood.

Percussion-flaking produced the flakes of Group II which are described as thinning-flakes that have a minimum thickness of 2-3 mm. These flakes tend to be longer and wider than flakes characteristic of Group I. Only 13 percent of the total flakes fit this description. Such flakes result from the final stages of reducing lithic material to blanks and preforms and from thinning those pre-tool forms.

The final category (Group III) consists of flakes of variable size which result from percussion- flaking that grossly reduced raw lithic material in the form of blocks, pebbles, and cores. Group III includes primary and secondary reduction flakes and interior shaping flakes that are greater than 3 mm in thickness. Two percent of the flakes fall in this group.

**Table 15.** Lithic Debitage Percentages by Groups.

| Lithic Material | n | Group I | Group II | Group III | Shatter |
|---|---|---|---|---|---|
| Chert | 769 | 613=80% | 121=15% | 32=04% | 3=01% |
| Chalcedony | 579 | 515=88% | 36=06% | 22=04% | 6=20% |
| Quartzite | 177 | 145=82% | 28=16% | 4=02% | 0=0% |
| Porcellanite | 56 | 48=86% | 8=14% | 0=0% | 0=0% |
| Dacite | 461 | 371=80% | 90=20% | 0=0% | 0=0% |
| Silicified Wood | 9 | 0=0% | 6=67% | 3=33% | 0=0% |
| Siltstone | 100 | 0=0% | 14=14% | 0=0% | 0=0% |
| Obsidian | 534 | 478=90% | 53=09% | 3=01% | 0=0% |
| **Totals:** | **2,685** | **2,256=84%** | **356=13%** | **64=02%** | **9=01%** |

Shatter fragments are blocky pieces of lithic debris that lack preparation for flake removal (platform, bulb or percussion, and so on), but which result from the reduction of raw material. Nine specimens (.1%) of shatter were recovered.

It appears that only the final stages of tool production were carried out at Thompson Bottom, because of the preponderance of finishing and resharpening flakes. However, such conclusions may be spurious because of the rather specialized pebble technology represented at Thompson Bottom. The small percentage of shatter and Group III flakes (true waste accumulated as a result of the reduction process) may be an artifact of such an efficiency-oriented technology.

## Battered or Pecked Cobbles

*Leslie B. Davis*

These artifacts were created by the breakage, abrading, or scraping of river cobbles. Such modification often is unintentional, but results from continued use of an artifact originally adopted for use in its natural form. At Thompson Bottom, four river cobbles display modification associated with use (Figures 19-22).

**Anvil Stones** (Table 16). Three river cobbles recovered by excavation display small areas of abrasion where it appears that a percussive force was responsible for the removal of bits of the cobble. These pecked, abraded areas occur near the center of one surface on two specimens, and near the center on two surfaces on the remaining artifact (Figure 20a,b). Anvil stones were evidently used as a stable, durable platform for performing a variety of tasks that involved percussive force. Such tasks include butchering, breaking, and smashing bones for marrow extraction, reduction of lithic material, and similar activities. Specimen 27, found beneath a canid skull (Figure 21), might be related to the killing or butchering of that animal.

## Earthenware Ceramics

*Ann M. Johnson*

## Introduction

Earthenware pottery was collected from separate locations at Thompson Bottom, on two occasions. Twenty-eight sherds, plus some split crumbs, comprise the main sample. Potsherds were examined using both natural and artificial light. Colors were measured on wet sherds, using a Munsell color chart. Magnification was provided by a Bausch-and-

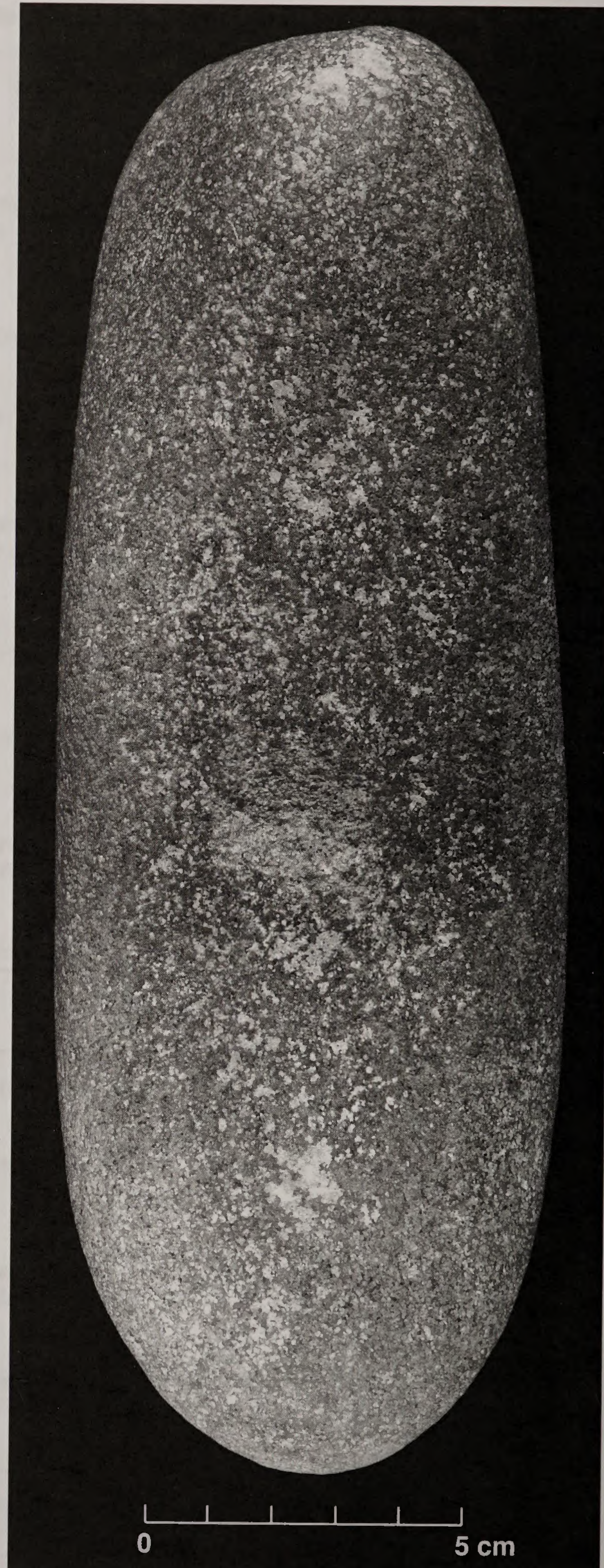



**Figure 19.** Anvil stone.


**Figure 20.** Anvil stones.

**Figure 21.** Hammerstone/anvil in context with shattered canid cranium and mandibles.


Lomb binocular microscope with light attachment. Weights were taken on an OHaus Dial-O-Gram scale.

For analysis, the collection was sorted into discrete vessels (Figure 23) according to paste, form, and surface treatment. Each vessel is described individually below.

# Vessel Descriptions

## Vessel 1

**Sample:** One large rim, one shoulder, and one body sherd. (The body sherd matches the shoulder, decreasing the sample size by one.) (Figure 23d) 46.3 gm.

**Paste:**

**Clay:** The clay body has not been analyzed, but it is assumed to be of local origin. Clay deposits are readily available locally throughout the Northern Plains.

**Figure 22.** Split cobble chopper/cleaver.

**Table 16.** Cobble Stones: Formal and Functional Attributes (cm).

| Specimen Number | Condition | Dimensions L | W | T | WT (gm) | Lithic Material | Comments/ Use Wear |
|---|---|---|---|---|---|---|---|
| 27 | whole | 22.8 | 8.5 | 20.50 | 4.3 | pale brown quartzite (10YR6/3) | On one relatively flat surface of the cobble, a 20-mm diameter area of pecking and abrasion is visible; single-sided anvil. |
| 92 | whole | 16.3 | 7.7 | 12.50 | 2.5 | pinkish-gray quartzite (7.5YR7/2) | On two surfaces near the center of the cobble are areas of pecking and abrasion; double-sided anvil. |
| 91 | whole | 15.7 | 7.9 | 13.60 | 2.7 | light reddish-brown quartzite (5YR6/4) | Round end pecked and has a small area of pecking and abrasion near center; single-sided anvil. |

**Temper:** Crushed granite or grit temper is plentiful. Individual pieces are most commonly 1-2 mm in diameter, with the .5 to 1 mm size also plentiful. The rim contains a few oblong aplastic chunks in the 3-5 mm size.

Method of Manufacture: Unknown, but mass-modelling during at least part of the process likely. Paddling that shaped and compacted the vessel walls was followed by the partial smoothing of selected areas.

**Texture:** The paste is finely blocky with ridges and valleys on the broken edges about 1 mm in height. The rim is thickest and appears to have a slightly contorted paste that the thinner sherd lacks. The paste is compact. Temper is evenly mixed with the paste, and there are no laminations parallel to the vessel walls.

**Hardness:** 3.5 (Moh's scale).

**Color:** The rim is black (exterior, core, and interior), (Munsell color 10YR3/2, very dark grayish brown), except that the lower third of the interior surface is very dark gray (2.5Y3/3). This color difference is apparently the result of post-depositional exposure.

The shoulder is very dark gray (2.5Y3/3) for the interior, core, and part of the exterior. The remaining portion of the exterior is dark yellowish brown (10YR4/4). This contrasting color pattern is attributed to conditions in the firing process, although it could be the result of post-depositional weathering.

The lip and upper portion of the interior rim retain a charred crust that is very thin, ca. .1 mm thick. This charred material may have been removed from adjacent areas during laboratory processing.

**Surface Finish:** The interior is nearly smooth with faint, very shallow circular/oval depressions that represent the use of the fingers during modeling of the exterior rim, lip, and shoulder. The interior surface of the rim is slightly irregular and shows the initial surface erosion because of exposure of the sherd in the cutbank.

The lip appears to be slightly polished. Only 20 percent of the surface could be observed because of the black deposit. The shoulder interior also has this adhering black material.

The rim exterior has very faint, smoothed-over impressions. These are not believed to have been simple-stamped due to their irregularity and width. Fabric or net-impressions cannot be ruled out, but cord-impressions are regarded as the most likely; the rim and shoulder likely represent the same vessel, and the shoulder has cord-impressions.

The shoulder bears vertical cord-impressions, both above and below the area of greatest angle, where the impressions had been largely removed by horizontal-smoothing. Width of the smoothing is about 1.8 cm, an area that could be covered by my thumb. Modeling clay was used to obtain a negative impression of the cord, but the results are inconclusive due to the shallow depth (no more than ca. .1 mm) of the impressions and subsequent smoothing of the ridges. The cord was about 1 mm wide and may have been a single ply with only a slight twist (P2, shoulder, Figure 23e).

## Form

**Rim:** This vessel has a high, vertical, very shallow "S" profile. The curvature is probably the result of pressure applied to flatten the lip and decorate the upper rim. The thickness tends to remain uniform, with localized areas of

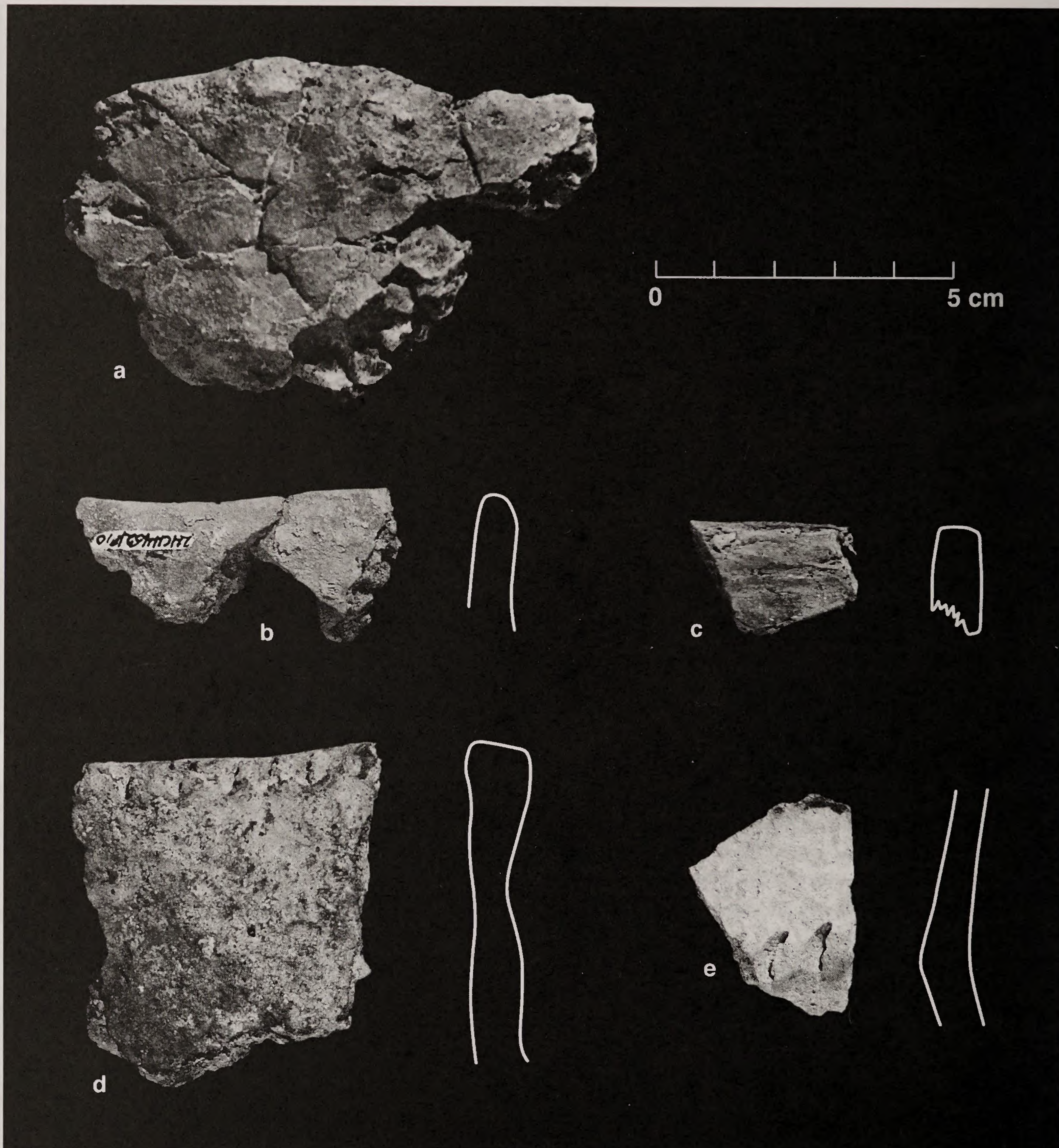



**Figure 23.** Body and conjoined earthenware pottery rim sherds, with body profiles.

slight variation. The sherd terminates with a slight curvature and thickening, suggesting that this vessel had a neck (Figure 23d).

**Lip:** Flattened and 1.1 cm wide. Excess clay was pushed to the exterior and smoothed into the upper edge of the rim. The lip slopes slightly down toward the interior of the vessel.

**Shoulder:** Carinate. The shoulder is thickest at the point of greatest angle and tapers above and below this point.

**Decoration:** The thickened area at the junction of the rim and lip contains a single row of tool impressions 6 mm long. These are set at the upper right/lower left diagonal at 40-45°. The side of the tool that was pushed into the clay tapered to a sharp thin edge. The angle of the shoulder also has a horizontal row of diagonal tool impressions, although the orientation of the diagonal cannot be determined with the portion of the remaining shoulder (Figure 23e, shoulder). These tool impressions are 8 mm tall and horizontal smoothing partially masks them by returning clay to the holes. Different tools appear to have been used on the rim and shoulder.

**Comment:** These sherds were recovered from a shallow hearth excavated in 1972 about 25 m upstream from Area A at Thompson Bottom (Davis 1976:63) (Figure D). Although black charred material adhering to vessel interiors is almost universally identified as charred food, it seems equally likely that, in this case at least, the black residue represents charcoal from the hearth.

## Vessel 2

**Sample:** One large rim section, four rims, one basal section, 14 sherds, and 10 split sherds (Figure 23a), 198 gm.

**Paste:**

**Clay:** See description of Vessel 1.

**Temper:** Rounded sand (quartz) grains, 1 to 4 mm in diameter.

**Method of Manufacture:** Unknown, but mass-modeling likely.

**Texture:** Very blocky with up to 3-mm vertical difference between the ridges and valleys of the broken edges. Temper appears to be equally distributed in the clay. There is a distinct tendency toward platiness, that is, the clay wants to split parallel to the vessel walls. The result is that, although the original break may have been more or less at 90° to the surfaces, subsequent breakage tends to remove more of one surface than the other, leaving an angle considerably less than 90 percent, jagged edges, and more split sherds.

**Hardness:** 3.5 (Moh's scale).

**Color:** The interior surface is black (10YR2/1) to very dark gray (10YR3/1). The core is often the same color as the interior or slightly lighter, such as reddish brown (2.5YR4/4). The basal section has a dark brown (10YR3/3) rind just under the exterior surface that is almost 3 mm thick. This rind appears orangish when dry. The exterior is dark yellowish brown (10YR4/4) or very dark grayish brown (10YR3/2).

**Surface Finish:** The exterior is relatively smooth, although widely separated, shallow undulations are present. The surface is marked by fine striations that appear on almost every sherd. No particular orientation can be inferred. They may have been caused by bits of temper being drawn across the surface during smoothing. Grains of temper can be seen occasionally on the exterior surface, but they do not protrude beyond the plane. A floated surface of about .1 mm does exist and, in some cases, has been chipped away, exposing a piece of temper just beneath the surface.

The interior is coated with a black charred layer that is greater than .1 mm thick in some places. For body sherds, where the interior could be seen, the appearance was very much like the exterior-smoothed with tiny striations. For the interior of the rim, the surface was irregular with incomplete horizontal smoothing, leaving pits and ridges (Figure 23b-c).

The lip is intermediate in smoothing between the interior and exterior rim. Some smoothing occurred around the vessel mouth; however, this was insufficient to completely shape the lip (see form below), and ridges of clay remain sharp.

**Form:** The vessel appears to have had a neckless cocoanut shape. The rim was essentially vertical or slightly insloping, and it blends into the body without a distinct shoulder. The lip in some areas is more or less flat and beveled down and into the interior, while, in an immediately adjacent area, the lip is more or less rounded. The base is thick and subrounded. The vessel wall is narrowest at the lip and gradually thickens toward the base. The lip width varies from 3.7 to 6.1 mm; the rim 8 to 10 mm; and the base is 12 mm thick.

**Decoration:** None.

**Comment:** A number of sherds from Vessel 2 and Vessel 3 have a $CaCO_3$ deposit on part of the surface. The deposition of caliche relates to post-depositional conditions within Occupation Zone 3.

The rim segment (P26) (Figure 23a) had been crushed flat by the weight of the overlying sediments and it was stabilized as a unit during excavation. This figure, then, is a distorted view of the upper vessel.

Little care had been taken during the manufacturing process, as is seen in the incomplete smoothing, variation in lip profile, and failure to remove or smooth over the clay ridges.

## Vessel 3

**Sample:** One body sherd (10.2 gm).

**Paste:**

**Clay:** See description for Vessel 1.

**Temper:** The plentiful crushed grit has a wide size range, from 1 to 8 mm in diameter, although most are in the 1-3 mm size range. A few rounded grains may be natural inclusions in the clay.

**Method of Manufacture:** Unknown, although paddling occurred during some stage of the process.

**Texture:** The paste is fine to medium blocky. Temper is evenly mixed with the clay, and the paste is compact. The sherd has good integrity, with sharp strong edges and no cracks or laminations parallel to the vessel walls.

**Hardness:** 3.5 (Moh's scale).

**Color:** The exterior, core, and interior are black (7.5YR2/0).

**Surface Treatment:** Since the surface area is small, inferences must be tentative. Modeling clay was used to obtain a negative impression that suggests use of a fabric-impressed surface. A larger sample might clearly show a cord-impressed surface. Individual strands are composed of a fibrous material with a very slight twist. One strand in particular appears to have been woven over and then under several other strands at a time. The angle is about 45°.

Because the interior is coated with black residue, it was not observed.

**Form:** This body sherd has straight parallel walls and cannot be placed more precisely on the vessel. This sherd varies from 7.8 to 9.8 mm in thickness.

## Discussion

The Thompson Bottom site contains pottery from two locations that are easily separated on the basis of paste, form, surface treatment, and decoration. Vessels 2 and 3 were found in Area A, Occupation 3, while Vessel 1 was recovered from a feature a short distance upstream (see Figure 1).

Inherent in the interpretive utility of most Northwestern Plains ceramics collections is the problem posed by small samples: only a fraction of the actual ceramic assemblage variability is present in the usual sample. This fact naturally complicates detailed comparisons of ceramic collections that are too small to contain sufficient overlap of significant attributes. At this point in the reconstruction of Northwestern Plains culture history by recourse to ceramics, basic descriptions accompanied by clear illustrations are the most useful and durable results.

In the case of Thompson Bottom, comparisons with other collections are facilitated by effective radiocarbon dating. For example, since Occupation 3 in Area A dates in the 300-200 B.P. range, comparison need not be made, for example, with ceramics from the Highwalker site (24PR627) which dates ca. 950-850 B.P. (Keyser and Davis 1982). The Stark site (24ML564) is closer geographically and is approximately the same age as Thompson Bottom, that is, 250 $\pm$ 100 B.P. (RL-768, uncorrected) (Davis et al. 1984), but is not regarded here as historically related.

Given the Northern Plains location of Thompson Bottom, we expected that ceramic similarities would be found to the north, and we were not disappointed. Potsherds from three vessels constitute the Thompson Bottom ceramic assemblage. These pots are assigned to one of two ceramic traditions by reference to paste, form, surface treatment, and decoration. The first unnamed tradition is represented by Vessels 2 and 3 from Occupation 3 in Area A. Vessel 2 is more complete since rim, body, and basal sherds are available. These allow reconstruction of general shape, although size is not known. If the vessel diameter is only slightly less than the height, then this neckless pot can be described as a "cocoanut" in shape (cf. Byrne 1973:Plate 12). If, however, the vessel is higher and deeper, the shape would be more like that of the vessel from the Pouliot site (24GL1002) (Johnson 1975). There are, unfortunately, no radiocarbon dates from Pouliot. Similarities between Vessel 2 and the Pouliot pot are evident in shape and edge-breakage pattern; however, possibly significant differences

exist in thickness, surface treatment, and paste. These differences are of sufficient magnitude as to indicate different ceramic traditions.

The Pouliot vessel was originally attributed to a deteriorating ceramics manufacturing tradition (Johnson 1975:63). This view is no longer tenable since no data were gathered to support it at the time and there is no basis for assuming that these particular people ever made better quality pottery. The Pouliot vessel most likely represents the Saskatchewan Basin complex. Vessel 3 is represented by a fabric-impressed, straight-sided body sherd. Fabric-impression, as a surface treatment, appears late and, relative to Thompson Bottom, has a northerly distribution since it is most common in the Canadian prairie provinces. Fabric-impression is one of three types of surface treatment recognized in the Ethridge collection from Toole County (Wedel 1951), but no closer meaningful comparisons can be drawn from a single potsherd.

Vessel 1, which was recovered some 25 m upstream from Area A and in a stratigraphically higher and therefore more recent context, is assigned to a second unknown ceramic tradition. Vessel 1 has two sherds, a rim and a shoulder, which represent the critical juncture for estimating original vessel shape. Because the Vessel 1 sherds were salvaged from a weathering cutbank prior to the excavation at Thompson Bottom in 1975, the stratigraphic relationship between Vessel 1 and Vessels 2 and 3 cannot be known with certainty. Vessel 1 was slightly higher in the profile than Occupation 3 in Area A. While these data are indicative of multiple ceramic-using events, the temporal distance between the two cannot be great, possibly no more than two or three generations, that is, 80 to 120 years or so, and possibly less.

Two prehistoric sites in Toole County yielded ceramics that bear similarities to Vessel 1, the first of which is the Galata site (24TL26) (Miller 1963). That collection includes both cord-impressed and smoothed sherds. A smoothed-over cord-impressed vessel has a shallow "S" rim and a pinched shoulder. Another smooth rim has a scalloped lip that was not observed in the Thompson Bottom collection. Such differences are to be expected when small collections are compared and they are difficult to interpret. The single radiocarbon date (SI-89) from Galata is 270 ± 60 B.P. (uncorrected), which is close in time to the age estimated for this Thompson Bottom component.

The Ethridge site contained shallowly buried cultural deposits and surface materials in the process of being deflated by erosion (Wedel 1951:130). These ceramics appear to be protohistoric or very late prehistoric, and it is assumed here that a single ceramic component is represented by this collection. Three types of surface treatment are present: fabric-impressed, cord-impressed, and smoothed. Shoulders are angled or carinate and were decorated by vertical or diagonal-incising. The Ethridge collection is much larger than this Thompson Bottom component and the former includes decorative techniques and surface treatments not observed at Thompson Bottom. Not having examined the Ethridge collection, we cautiously emphasize the similarities with Thompson Bottom and assign Vessel 1 to Ethridge Ware (Kehoe 1959). While the Galata site pottery may also be Ethridge Ware, some disagreement exists regarding this possibility (Kehoe 1959:238).

Ceramic collections maintained by the Department of Archaeology at the University of Calgary from the Ross, FM Ranch, and Trout Creek sites were recently examined. These sites were assigned to the Late Variant of the Saskatchewan Basin Complex of southern Alberta (Byrne 1973). There are significant differences in the overall "character" of this pottery compared to the Montana collections discussed above, probably the most striking feature among which is a thickness that borders on massiveness that is characteristic of the Late Variant pottery. Byrne (1973:367) states that, "neither [Late or Early Variant] of the major ceramic complex seem to be represented in the materials collected from the Milk River area." The Milk River area to which he refers lies just across the International Boundary in southern Alberta. Byrne appears to have defined one limit of distribution for the Late Variant of the Saskatchewan Basin Complex. Based on our observations, it is likely that he is correct. Few Montana ceramic sites have been identified as associated with the Late Variant. However, Keyser (1979) did identify several at Tiber Reservoir. If some ceramic sites eventually are so related, those sites will likely be located close to the Montana-Alberta border.

## Summary

Potsherds from Thompson Bottom represent three vessels derived from two different components. Vessel 1 was found in situ a short distance upstream from excavated Area A from which Vessels 2 and 3 were recovered in situ. Reconstruction of Vessel 1 suggests that it is a globular pot that had a nearly vertical high rim, a distinct neck, and a decorated shoulder. The body surface is smoothed cord-impressed. This vessel is attributed to Ethridge Ware, and more care was taken in its production than was the case with Vessels 2 and 3. Vessel 2 is a wide-mouthed, neckless pot that has a smoothed surface and was not decorated. Vessel 3 is represented by a fabric-impressed sherd. General comparisons made for these two pots suggest that the closest historical relationships likely lie to the north.

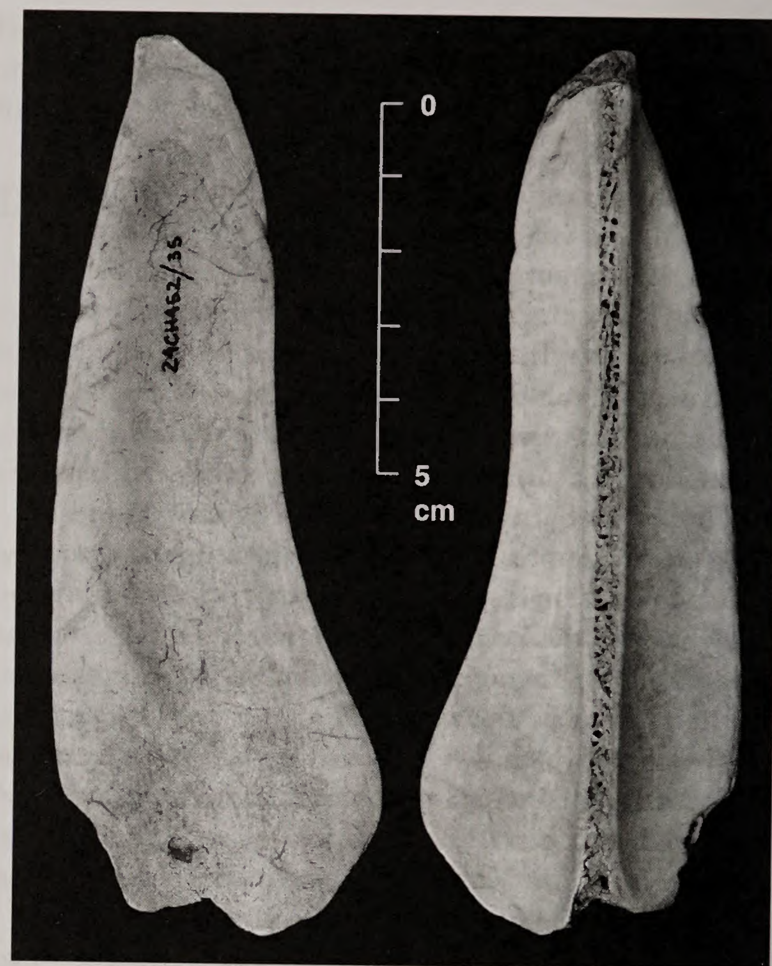



Figure 24. Canid scapula paddle.

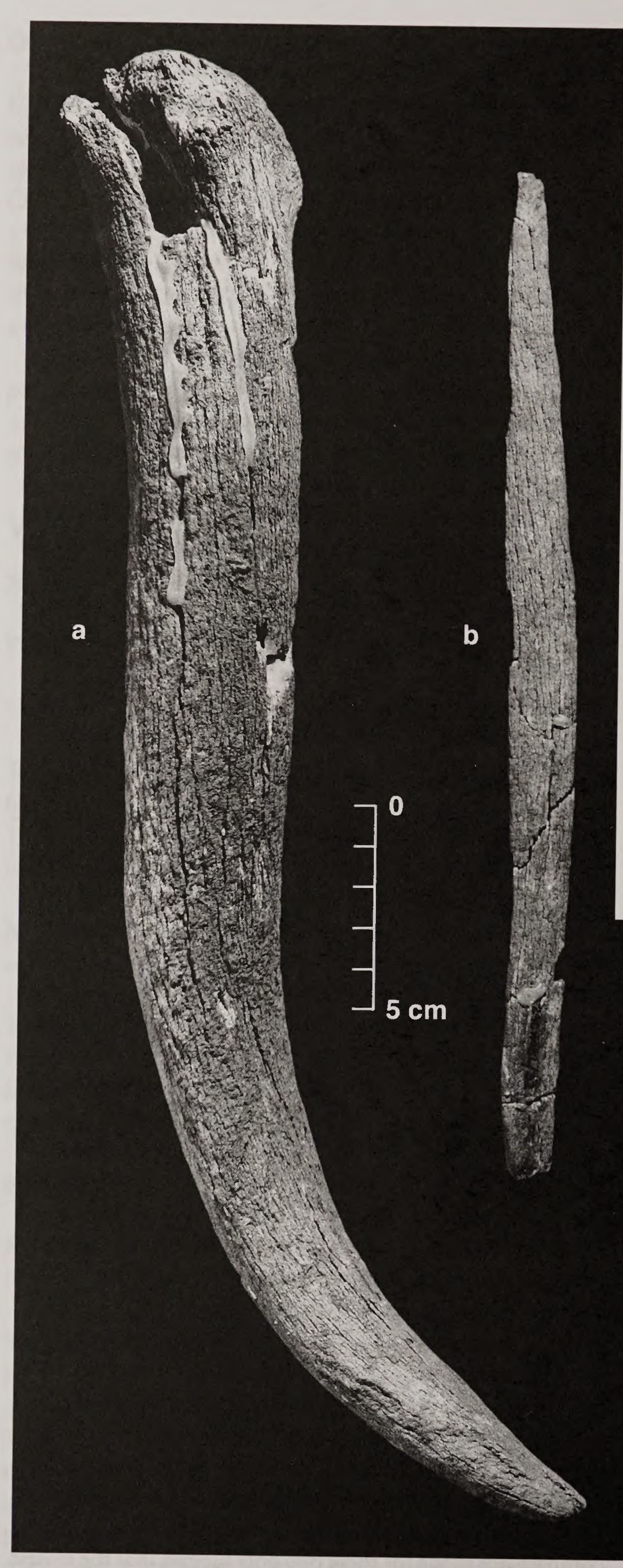




Figure 25. Wapiti antler brow tine fleshing tool (a) and a split, trimmed bison rib knapping tool or quill flattener (b).

**Figure 26.** Wapiti mandible in situ.

Thompson Bottom is one of a handful of ceramic sites in Montana with which radiocarbon-dated occupational components bearing ceramics are associated. The vessels described herein date in the 300 to 200 B.P. range, which places them late in the Late Precontact Period. The cultural dynamics for this period on the Northwestern Plains are very complex, with Hagen (Mulloy 1942) and Nollmeyer (24RL1225) (Johnson 1982) major Montana ceramic sites occupied at about that time. The work at Thompson Bottom is one small, but necessarily basic step toward bringing structure to scattered bits and pieces of existing late ceramic data. Many more such sites are needed before a local ceramics chronology can be persuasively constructed and proposed with any likelihood of viability.

## Bone, Antler, and Shell Artifacts

Figure 24 is an intentionally carved, shaped canid scapula with the acromion trimmed off. This modified bone was likely used as a paddle to assist in the shaping of ceramic vessels. A wapiti antler brow tine fleshing tool was recovered in situ (Figure 25a) (see Figure 26 for provenience of wapiti mandible). The flat abrasion at the tip would have enabled the lashing of an end scraper. Held in place by sinew, this handle would permit the application of force at the distal end of an end scraper being applied to removal of fat from animal skins. Figure 25b is a split, trimmed bison rib that could have been used as a paddle, a stone-knapping tool, or a quill flattener. Figure 27 shows a burned (hardened) long bone fragment with a heavily polished distal end (a), an incised, utilized bison rib (b), and last a typical carnivore-gnawed bison bone fragment (c).

A cut and polished ornamental or otherwise decorated non-utilitarian mussel shell artifact was recovered amidst mussel shell detritus (Figure 29).

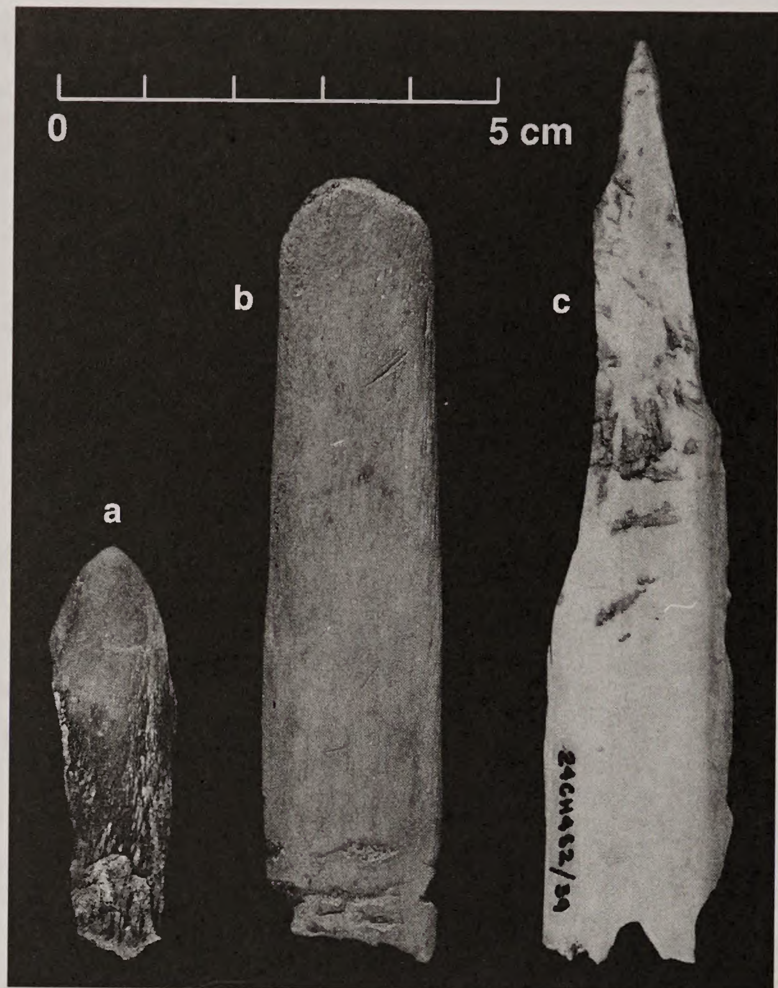



**Figure 27.** Modified bones: a, fire-hardened, polished end tool; b, polished distal end rib with stone tool cutmarks at proximal end; c, carnivore-gnawed bone fragment.

**Figure 28.** Pronghorn (a) and wapiti (b) mandibles.

# The Archaeofauna

*Michael C. Wilson and T. Weber Greiser*

## Introduction

*Michael C. Wilson*

Approximately 1,000 bones, teeth, antler, and clam shells from Thompson Bottom were analyzed. Detailed results are tabulated in Appendix C. Materials are treated as a single archaeological fauna of Late Precontact affiliation and age. The fauna is relatively rich in species (Table 17), but is dominated by the utilized remains of bison (*Bison bison bison*) and canids (*Canis* spp.). The remaining part of the fauna comprises scarcely more than one or two handfuls of specimens, aside from the pronghorn (*Antilocapra americana*) (a) and wapiti (*Cervus elaphus*) (b) (Figure 28) mandibles.

## Butchering Techniques

The Thompson Bottom site sample is rich in broken bison bones, almost all of which display extensive evidence of dog-chewing. Studies of modern kill sites show that wolves can cause spiral-fracturing of even bison bones (Haynes 1982). As a result, the data do not point unambiguously to humans as the sole agent of breakage. Indeed, most of the observable fractures are attributed to scavenging canids.

Cleaver marks on neural spines of thoracic vertebrae indicate detachment by battering near their bases. Cut marks are relatively uncommon in the sample, but show up most often on ribs, generally on the outer curve just below

**Figure 29.** Two views of a cut and polished section of freshwater mussel shell.

**Table 17.** Archaeological Fauna Species List.

| | |
|---|---|
| **PHYLUM MOLLUSCA** | |
| **Class Pelecypoda** | |
| 1. *Dentalium* | tusk shell |
| **Class Gastropoda** | |
| 2. cf. *Discus* sp. | snail |
| 3. *succineid snail* | snail |
| **Class Pelecypoda** | |
| 4. *pelecypod* | river mussel |
| **PHYLUM CHORDATA** | |
| **Class Amphibia** | |
| **Order Anura** | |
| 5. cf. *Bufo* sp. | toad |
| **Class Aves** | |
| **Order Galliformes** | |
| 6. cf. *Pedioecetes phasianellus* | grouse |
| **Order undetermined** | |
| 7. large bird | bird |
| 8. sparrow-sized bird | bird |
| **Class Mammalia** | |
| **Order Lagomorpha** | |
| 9. *Lepus townsendii* | white-tailed jackrabbit |
| **Order Rodentia** | |
| 10. *Castor canadensis* | beaver |
| 11. cf. *Spermophilus* sp. | ground squirrel |
| 12. cf. *Cynomys* sp. | prairie dog |
| 13. cf. *Peromyscus* sp. | mouse |
| 14. *Microtus* | vole |
| 15. *Erethizon dorsatum* | porcupine |
| **Order Carnivora** | |
| 16. cf. *Vulpes* sp. | fox |
| 17. *Canis latrans* | coyote |
| 18. *Canis* sp. | large canid (dog/wolf) |
| **Order Artiodactyla** | |
| 19. *Antilocapra americana* | pronghorn |
| 20. *Cervus elaphus* | wapiti |
| 21. *Bison bison* | bison |

the area of the tubercle. A few occur at midshaft or near the distal end. Cut marks are also seen on the anterior face of a metacarpal and on a few other long bone fragments. On the whole, the sample tells us little about cultural butchering practices because of the superimposition of modification by scavenging canids.

Canids themselves impose selective patterns -- not simply random damage -- on skeletal remains (Wilson 1983).

## Seasonality

*T. Weber Greiser*

Two sets of evidence permit seasonality inference: fetal remains of bison and bison dentitions. The fetal remains are numerous and are almost all tiny, suggesting a time early in gestation. A small number of near-neonatal or even newborn individuals was also noted. That would suggest occupation at some time or times from early winter to spring; but the sequence is not a continuous one.

Mandibles and maxillae with erupting teeth are all in fairly close agreement regarding absence of wear on the erupting molar (whether it be $M_1$, $M_2$, $M_3$), or only slight wear on cusps I-II. A single example has wear on cusps I-IV and none on VII-VIII. The absence of wear would suggest a fall event, while the most worn example is consistent with a late winter event.

Given the limited nature of the dental sample and the need for comparative material in the case of fetal remains, these determinations should be considered tentative.

## Bison and Canid Remains

Following are a discussion and interpretation of the two most frequently represented genera at Thompson Bottom: *Bison* and *Canis*. The excellent state of preservation of the faunal remains suited them ideally for analysis of the cultural and natural processes that transformed them into their current condition.

### Bison

Methodological and theoretical groundwork laid by previous analysts (Frison 1967a, 1970, 1973, 1974; Lorrain 1968; Wheat 1972, 1979; White 1952, 1953, 1954) was employed to analyze the bison remains. Investigators of Precontact bison procurement have demonstrated that careful analysis of bone element frequencies, bone breaks, chops, and cut marks contributes greatly to understanding of the bison-butchering activities of early Native Americans.

Analyzing butchered bison remains is designed to reconstruct the killing and butchering activities that determined the character of the bones when they were originally deposited in the ground. In attempting to attribute certain breaks, cuts, or disproportionate element representation, cultural activities of the human occupants as well as other natural processes such as weather, soil, plants, and animals must be considered. The bones display no exfoliation (Miller 1975) or rootlet-etching, which indicates that they were probably buried quite rapidly and deeply. A total of 515 (56.8%) of the catalogued entries are bison, which were subdivided into adult (395), juvenile (41), and fetal (79 entries for 152 elements or major fragments). Bison bones that could be identified by element and side are summarized in Table 18; 55.7 percent of the total is included: adult (188); juvenile (21); and fetal (78). If an element was not complete, then at least one-half of the described fragment had to be present in order to be tabulated as adult or juvenile. Juveniles are defined here as less than 2 years of age, and assignment to that category was based on size and degree of fusion relative to a recent juvenile skeleton. Fetal elements or fragments less than one-half complete are included if enough bone was present to identify the element and if it was certain that it would not be counted twice.

In addition to the relatively intact, identifiable elements, 209 adult bone fragments included numerous rib fragments, thoracic neural spine fragments, and lumbar transverse processes, but no centrum fragments. There are also a few skull, sacrum, innominate (1/2 pelvis), and long bone fragments. The 20 juvenile bone fragments include a few skull, thoracic spine, lumbar transverse process, humerus, femur, and tibia fragments. A total of 78 fragmented fetal bones occur, which includes non-specific axial as well as appendicular elements. No heavily fragmented or crushed bone, such as results from bone grease-processing, was recovered.

The well-preserved bison bones in the Thompson Bottom sample tend to be either large, identifiable fragments or complete bones. As one might expect, fetal bones are fragmentary because of the lack of ossification.

Carcasses of recently killed bison were subjected to a series of butchering processes, with the goal of meat removal for human consumption. Activities related to primary-processing of bison at the kill locality included skinning and partitioning the carcass into seven or more skeletal and several non-skeletal units (Wheat 1972). The number of units or packages was influenced by such variables as number of people involved, number of animals killed, distance to be carried, weather, season, and so on. Based on ethnographic summaries and historic accounts (Wheat 1972), contemporary butchering observations among

Eskimo (Binford 1978), and archaeological evidence from two kill sites (Frison 1974; Wheat 1972), the following primary butchering units follow Wheat (1972):

(1) skulls with or without mandibles;
(2) neck units (cervical vertebrae);
(3) vertebral column, with or without ribs;
(4) pelvic girdle units (sacra with a few lumbar and various rear leg elements);
(5) front leg units;
(6) rear leg units; and
(7) foot units.

Secondary-processing is defined here as a series of organized activities through which the resources of the bison were procured. These postulated activities include meat and ligament removal, extensive disarticulation, and bone breakage for marrow extraction and bone grease processing, in addition to bone tool manufacture. Since discard of bones may occur at any point during these processing activities, recoverable data range from major units of articulation to splintered fragments.

The distinction between primary and secondary-butchering activities often made is somewhat heuristic. The degree of butchering that occurs at kill sites versus butchering sites is variable. If all phases of killing and butchering occurred at a single location, then there would be no discernible break in processing. Thus, these kinds of butchering are regarded as flexible guidelines, rather than as hard and fast rules.

Based on the Thompson Bottom sample, meat packages from adult bison were primarily rib slabs, hump roasts which contain the thoracic neural spines, loins with lumbar transverse processes, and leg units generally lacking the lower leg bones. Bones absent from the sample are the upper vertebrae, centra from middle and lower vertebrae, and the caudal vertebrae. These bones are generally associated with low muscle mass parts of the body and would be some of the first items discarded or left at a kill site.

A large proportion of the bones of juveniles is missing. Potential explanations for this deficit include differential preservation or higher consumption of juvenile elements by carnivores. Fetal bones, on the other hand, have a higher frequency than juvenile bones, indicating that the fetuses were brought to the site intact or that the site was at or near the location of the kill as well as being the location of extensive post-kill carcass-processing.

Cut marks, interpreted as the result of meat removal from bone by human occupants of the site, were observed on 28 adult and two juvenile bones. More than 67 percent (n=19) of the cut marks on adult bones occur on ribs or rib fragments. Tooth punctures and tooth-scoring from carnivore-chewing were noted on 157 adult and 16 juvenile bones. Because of the lack of ossification in the fetal remains, neither of those processes were observed on those elements.

Seven major fragments of bison mandibles and six major fragments of bison maxillae are present in the collection. Mandibles are the most frequent of all bison elements recovered, with six left and one right mandible present. The two left and four right maxillae add to the Minimum Number of Individuals (MNI) count. Based on combined tooth eruption and wear patterns of both mandibles and maxillae, dentitions from at least four adult and four juvenile bison are present. The presence of remains from three fetuses, plus the juveniles, indicate that, if all of the bison were killed at one time, they would represent a nursery herd with all or most of the adults being pregnant females. Based on tooth eruption and wear, primarily of the juvenile individuals, and a birthing peak of late April (Frison and Reher 1970; Frison et al. 1976; Wilson 1974; Reher 1970, 1973), the bison could have been killed and butchered between late summer and early fall (see dentition summary below). The fetal remains appear to indicate a late fall or early winter kill, although definitive fetal descriptions are not available for comparison. Multiple bison kill and butchering episodes could be represented.

### Group I Mandibles

1. C-28. Complete; left side; deciduous premolars in place; dP2 (C-58 was loose) and dP3 moderately worn; dP4 slight to moderate wear; M1 has the first cusp erupted and the second cusp emerging from the jaw. Probably less than a .4 year old, when compared with Wardell (Reher 1973), possibly a .3 year old.

### Group II Mandibles

2. C-677. Nearly complete; left side; deciduous premolars in place; dP2 missing; dP3 heavily worn; dP4 moderate to heavy wear; roots of dP3 and dP4 showing; M1 moderately worn; M2 erupted almost to level of M1, with very slight wear on first cusp; first cusp M3 barely visible in opening of jaw. Fits very well with 1.4 year olds from Wardell (Reher 1973).

3. C-849. Left tooth row; deciduous premolars in place; dP2, dP3, and dP4 all heavily worn and roots showing; M1 moderately worn; M2 fully erupted, with noticeable wear in places on first cusp; M3 missing, but only a slight gap in the bone is present, indicating it was just erupting. Stage of eruption of M2 fits better with 1.5 year olds from Glenrock (Frison and Reher 1970).

4. C-850. Left diastema plus anterior tooth row; incisors about to erupt; dP2 and dP3 heavily worn and roots showing; rest of tooth row missing. Fits well into the 1.4 to 1.5-year-old group.

**Group III Mandibles**

5. C-848. Right tooth row; deciduous premolars broken; P4 visible where dP4 is broken away; M1 and M2 erupted, but generally broken, moderate wear visible; M3 first and second cusps erupted, with slight wear on first and second still not free of jaw. Fits well with 2.4 year olds from Wardell (Reher 1973).

**Group IV Mandibles**

6. C-646. Left M2 and M3 in bone; M2 and M3 fully erupted and moderately worn. This is probably a mature animal, 5 to 10 years old.

7. C-847. Left M3 in bone; M3 fully erupted and moderately worn; tooth more worn and more robust than #646. This is a second mature animal, probably 5 to 10 years old.

**Group I Maxillae**

1. C-680. Right maxilla plus premaxilla; deciduous premolars in place; dP2, dP3, and dP4 have slight wear; M1 is just erupting and has no wear; M2 is missing. It is assumed that this maxilla is from the same individual as mandible #28; hence, a .3 to .4 year old.

**Group II Maxillae**

2. C-678. Left maxilla; deciduous premolars in place; dP2 missing (P2 barely visible in root cavities); dP3 and dP4 have moderate to heavy wear; M1 is fully erupted with slight to moderate wear; M2 is above the bone, but not in wear; M3 is missing (never erupted). This maxilla is probably in the 1.4-year-old category; it appears to occlude nicely with #677.

3. C-857. Right M1 and M2 in bone; M1 is fully erupted with moderate wear; M2 is fully erupted, with visible wear on all cusps. These teeth are from an individual slightly older than #678, based on eruption of M2. They may come from the same individual as #849; hence, it is 1.5 years old.
*Group III Maxillae*

4. C-676. Right maxilla; P3, P4, M1, and M2 all in and in moderate wear; M3 is missing. This is probably from a mature or nearly mature animal.

5. C-854. Right P2, P3, and P4 in bone; P2, P3, and P4 all in and in moderate wear. This is also probably from an animal older than #676 and #854.

## Pathologies

Pathologies observed in some archaeological collections of bison bones include tooth-crowding, malocclusion, missing teeth on cranial elements, and/or excess bone growth on cranial or postcranial elements. Cranial pathologies have been attributed to (1) an isolated gene pool in which fewer desirable recessive traits become dominant or (2) deterioration in environmental conditions, which reduces the size of bison populations. Excess bone growth is a more individual phenomenon resulting from trauma such as accidental breaks or severe bruises which healed improperly and resulted in extra calcification at and around the break or bruise. The only possible anomalous features in the Thompson Bottom bison sample are lesions in the diaphyses of two first phalanges. Since the epiphyses are not completely fused, they may be from a young individual and the lesions might have disappeared with maturity. In general, the population represented by the sample appears to have been a healthy one, that lived in at least tolerable environmental conditions with a strong gene pool.

In summary, analysis of Thompson Bottom bison bone indicates that a minimum of four adult, four juvenile, and three fetal bison is represented. Since no complete skulls or horn cores were recovered, sex cannot be reliably assigned to any of the animals on that basis. Based on the presence of the one extremely young bison and the three fetuses, it is assumed that most, if not all, adults are female. Skeletal elements are generally disarticulated. Breaks into marrow cavities are quite common, but no evidence of bone-grease preparation or processing was recovered. The bison appear to have been composed of individuals not undergoing environmental stress, that were killed nearby at some time between late summer and early winter.

## Canids

Analysis of canid remains was focused on size and morphology of skulls and mandibles in order to differentiate wild from domestic species (Allen 1920; Frison et al. 1978; Haag 1948; Lawrence 1968; Lawrence and Bossert 1967; Walker 1975, 1980; Walker and Frison 1982). Compared to bison studies, less emphasis has been placed on the postcranial skeleton, probably because canid remains generally comprise a limited portion of archaeological faunal assemblages and they rarely display evidence of butchering. Existing metric formulae are applied here in an attempt

**Table18.** Bison Bone Element Analysis.

| | COMPLETE | | | PROXIMAL END | | | DISTAL END | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Adult | Left | Not Sided | Right | Left | Not Sided | Right | Left | Not Sided | Right | MNI By Element |
| Mandible complete & large fragments | 4 | | 1 | | | | | | | 4 |
| Maxilla | 2 | | 4 | | | | | | | 4 |
| Rib 23 | | 15 | 4 | 1 | 6 | 12 | 4 | 16 | 3 | |
| Scapula | | | 1 | | | 2 | | | | 3 |
| Humerus | | | | | 2 | | 1 | | 1 | 1 |
| Radius | | | | 2 | | 2 | 3 | | 3 | 3 |
| Ulna | | | | | | 4 | 2 | | 1 | 4 |
| Carpal | 13 | 3 | 3 | | | | | | | 4 |
| Metacarpal | 1 | | | 1 | | | | | 1 | 2 |
| Femur | | | | | | | 1 | | | 1 |
| Patella | | | 4 | | | | | | | 4 |
| Tibia | | | | 1 | | | 3 | | 4 | 4 |
| Lateral malleolus | 2 | | 2 | | | | | | | 2 |
| Astragalus | 2 | | 1 | | | | | | | 2 |
| Cubonavicular | 1 | | 2 | | | | | | | 2 |
| Tarsals | 1 | | | | | | | | | 1 |
| Metatarsal | | | | 1 | | | 1 | | | 1 |
| 1st Phalanx | 2 | 5 | 1 | | | | | | | 1 |
| 2nd Phalanx | 2 | 2 | 2 | | | | | | | 1 |
| 3rd Phalanx | 4 | 3 | | | | | | | | 2 |
| Mandible | 2 | | | | | | | | | 2 |
| Maxilla | | | 2 | | | | | | | 2 |
| Rib 3 | | 2 | 2 | | | 6 | | | 1 | |
| Metacarpal | | | | | | | | | 1 | 1 |
| 1st Phalanx | | | 3 | | | | | | | 1 |
| 3rd Phalanx | | | 1 | | | | | | | |
| Fetal | Major Fragments (none complete) | | | | | | | | | |
| Mandible | | | 1 | | | | | | | 1 |
| Premaxilla | 1 | | 2 | | | | | | | 2 |
| Atlas | | 1 | | | | | | | | 1 |
| Thoracic | | 2 | | | | | | | | 1 |
| Rib 9 | 15 | 5 | | | | | | | 1 | |
| Scapula | 2 | | 2 | | | | | | | 2 |
| Humerus | 1 | | 2 | | | | | | | 2 |
| Radius | 2 | | | | | | | | | 2 |
| Ulna | 3 | | 3 | | | | | | | 3 |
| Metacarpal | | 5 | | | | | | | | |
| Innominate | 1 ilium | 1 ilium and ischium, 1 ischium | | | | | | 2 | | |
| Femur | | | 2 | | | | | | | 2 |
| Tibia | 2 | 2 | 1 | | | | | | | 2 |
| Calcaneum | | | 1 | | | | | | | 1 |
| Metatarsal | | 4 | | | | | | | | |
| Metapodial | | 6 | | | | | | | | |
| 1st Phalanx | | 1 | | | | | | | | 1 |

to distinguish wild from domestic canids. A remarkable 33 percent of the Thompson Bottom faunal assemblage is identified as canid. A total of 299 faunal catalogue entries, representing 447 elements or fragments, are placed in one of four canid categories: wolf or dog-sized (n=104); coyote-sized (n=115); fox or small canid (n=34); and a general canid category (n=63) for unclassifiable elements from young individuals or for fragmentary pieces. Assignment to the first three categories was generally based on size comparison with known specimens, and was applied to complete elements or major fragments (Table 19).

Adult and older sub-adult canids comprise the majority of represented individuals. Age estimates for sub-adults are based on cranial fusion rates. The most commonly represented elements are vertebrae, ribs, teeth, and cranial fragments. Long bones are notably under-represented. Possible explanations for the over-representation of adults and the under-representation of long bones are discussed below. Both natural and cultural factors are considered.

As were the bison bone samples, the canid bones from Thompson Bottom tend to be generally well preserved. No exfoliation due to weathering or etching from rootlets was noted. Because these bones appear to have been rapidly buried, differential deterioration due to weathering can be ruled out as a factor to explain the disproportionate adult-to-young representation.

Forty-three bones display evidence of carnivore-chewing in the form of tooth punctures or tooth-scoring. In addition, eight of the chewed bones (including 7 phalanges) also have eroded surfaces, which Wilson (1983b) attributes to partial digestion. It is possible that many bones were consumed by carnivores at the site. Only compact bones such as adult canid phalanges survived the digestive process.

In comparison to cranial elements (skulls, maxillae, mandibles), canid postcranial elements are under-represented (Table 19). Numerous references exist in ethnographic and historic accounts regarding the consumption of young canids, primarily dogs, by Plains Indians. The older individuals were presumably less desirable, especially when bison meat was available, as was the case at Thompson Bottom. The greater representation of adult postcranial elements at Thompson Bottom may reflect that dietary preference (see below).

Bone bead production (Table 20) (Figures 30-34) may have contributed to the under-representation of lower leg elements. Manufacturing debris primarily consists of proximal and distal ends of metapodials and phalanges. Some elements had been scored, but are unbroken, indicating incomplete manufacture. Coyote bones appear to have been favored by site occupants for bead production although not to the exclusion of other canids. One might assume that various-sized canids were exploited in order to make beads of graduated sizes.

If canids were exploited, in large part, for their hides and as a source of bone for artifact production, it follows that adults and older subadults would have been emphasized. These older individuals would have provided thick fur (in winter) and bones sufficiently dense for bead manufacture. However, it is likely that a combination of the factors discussed contributed to the final composition of canid remains at the site.

Crania and mandibles provide the best data regarding minimum number of individuals (MNI) categorized, on the basis of size, as coyote and wolf/dog. No fox/small canid cranial remains were recovered, although see Table 19.

Present are highly fragmented bones from at least three coyote crania. Two pairs of mandibles appear to match individuals represented by the crania. As inferred from tooth wear, one older adult and two young adults or advanced subadults appear to be represented.

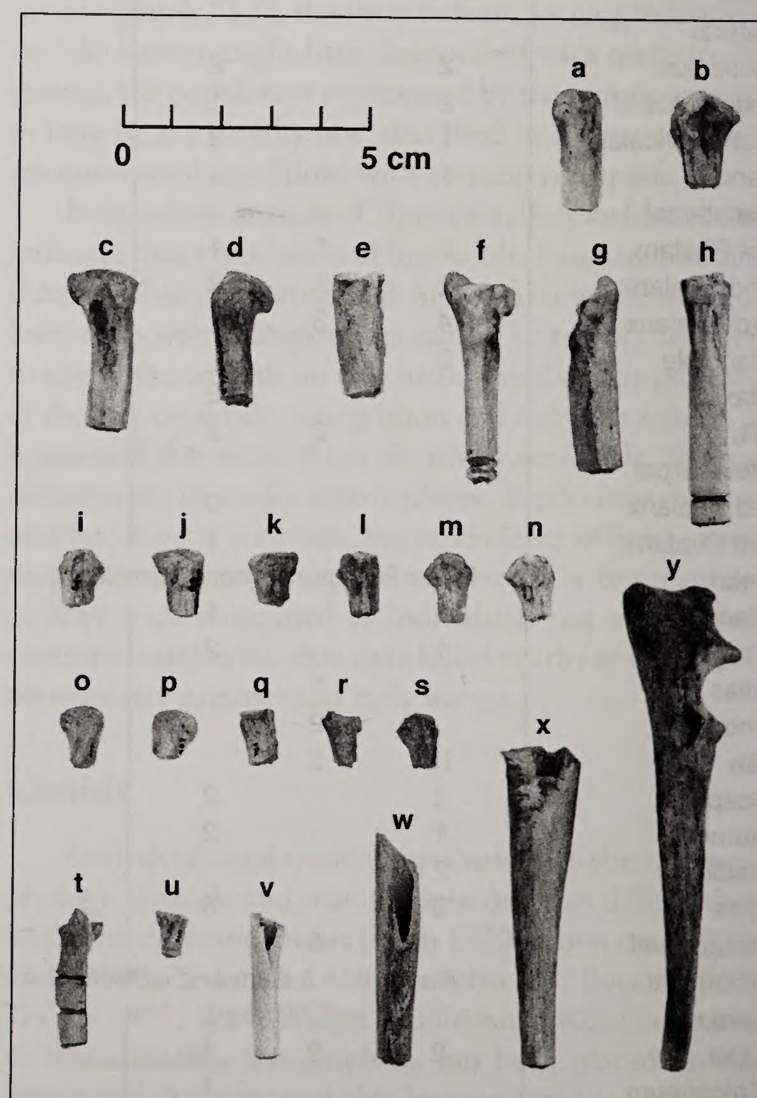



**Figure 30.** Canid ulna (w-y); indeterminate skeletal element (d); and proximal ends of metapodials (a-v).

**Table 19.** Canid Bone Element Analysis.

| | COMPLETE | | | PROXIMAL END | | | DISTAL END | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Canid | Left | Not Sided | Right | Left | Not Sided | Right | Left | Not Sided | Right | MNI By Element |
| **Canis sp. -- Size of Wolf or Large Dog** | | | | | | | | | | |
| Skull | | 3 | | | | | | | | 4 |
| Basicranium | | 1 | | | | | | | | |
| Mandible | 5 | | 6 | | | | | | | 6 |
| Atlas | | 3 | | | | | | | | 3 |
| Axis | | 2 | | | | | | | | 2 |
| Cervical | | 10 | | | | | | | | 3 |
| Thoracic | | 5 | | | | | | | | 1 |
| Sacrum | | 1 | | | | | | | | 1 |
| Rib | | | 2 | 16 | 14 | 12 | | | | 2 |
| Scapula | | | | 1 | | 1 | | | | 1 |
| Metacarpal | | | | 2 | | | 1 | | 1 | 1 |
| Innominate | 1 | | 1 | | | | | | | 1 |
| Femur | | | | 2 | | | | | | 2 |
| Tibia | 1 | | 1 | | | | | | | 1 |
| Fibula | 1 | 2 | | | | | | | | |
| Metatarsal | | | | | | 4 | | | | 1 |
| Metapodial | | 1 | | | | | | | | |
| 2nd Phalanx | | 2 | | | | | | | | |
| 3rd Phalanx | | 2 | | | | | | | | |
| **Canis sp. -- Size of Coyote** | | | | | | | | | | |
| Skull | | | 1 | | | | | | | 2 |
| Basicranium | | | 1 | | | | | | | |
| Maxilla | | 2 | | 1 | | | | | | 2 |
| Mandible | 2 | | 2 | | | | | | | 2 |
| Cervical | | 1 | | | | | | | | 1 |
| Rib | 2 | | | | 2 | | | 5 | | 1 |
| Scapula | | | | | | | | 2 | | 2 |
| Humerus | | | 1 | | | | | | | 1 |
| Radius | | | 1 | | | | | | | 1 |
| Ulna | | | | | | 2 | | 1 | | 2 |
| Carpal | | 11 | | | | | | | | 3 |
| Metacarpal | | | | 4 | | 4 | 6 | | 3 | 2 |
| Innominate | 1 | | 1 | | | | | | | 1 |
| Tibia/Fibula | | | | | | | 1 | | | 1 |
| Metatarsal | | | | 3 | | 3 | | | 2 | 1 |
| Metapodial | | | | | 1 | | | 1 | | |
| 1st Phalanx | | 7 | | | 10 | | | 9 | | |
| 2nd Phalanx | | 18 | | | | | | | | |
| 3rd Phalanx | | 4 | | | | | | | | |
| **Canis sp. -- Size of Fox** | | | | | | | | | | |
| Lumbar | | 1 | | | | | | | | 1 |
| Rib | 2 | | 1 | | 1 | | 1 | 2 | | 1 |
| Metacarpal | | 1 | 2 | | | | | | | 1 |
| Fibula Shaft | | 1 | | | | | | | | |
| Metatarsal | | | | 1 | | 1 | 1 | | | 1 |
| 1st Phalanx | | 3 | | | | | | | | 1 |
| 2nd Phalanx | | 3 | | | | | | | | 1 |
| 3rd Phalanx | | 5 | | | | | | | | 1 |

**Table 20.** Canid Bone Bead Production Debitage.

| | WOLF/DOG | | | COYOTE | | | FOX | | | CANID, INDETERMINATE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Adult** | **Left** | **Not Sided** | **Right** | **Left** | **Not Sided** | **Right** | **Left** | **Not Sided** | **Right** | **Left** | **Not Sided** | **Right** |
| Metacarpal | | | | | | | | | | | | |
| Lateral metacarpal | | | | | | | | | | | | |
| II Proximal | | | | 1 | | 1 | | | | | | |
| II Distal | | 1 | 2 | | 1 | | | | | | | |
| III Proximal | 1 | | | 2 | | 3 | | | | | | |
| III Distal | | | 1 | | | | | | | | | |
| IV Distal | | | | 1 | | | | | | | | |
| V Proximal | 1 | | | 1 | | | | | | | 1 | |
| V Distal | 1 | | | 2 | | 2 | | | | | | |
| Metatarsal | | | | | | | | | | | | |
| II Proximal | | | | | | | 1 | | | | | |
| III Proximal | | | 2 | 1 | | 1 | | | | | | |
| IV Proximal | | | 1 | 1 | | 1 | | | | | | |
| IV Distal | | | | | | 1 | | | | | 1 | |
| V Proximal | | | 1 | 1 | | 1 | | | | | | |
| V Distal | | | | | | 1 | 1 | | | | | |
| Metapodial | | | | | | | | | | | 5 | |
| III-IV | 1 | | | 1 | | | | | | | 3 | |
| 1st Phalanx | | | | | 19 | | | | | | 1 | |
| Shaft (unidentified) | | | | | | | | | | | 1 | |
| Ulna | | | | | | | | | | | | |
| Proximal | | | | | | 1 | | | | | | |
| Shaft | | | 1 | | 1 | | | | | | | |
| Beads -- genus or species not identified | | | 2 | | | | | | | | | |


**Figure 31.** Canid foot bones (a-f) girdled by a sharp stone tool as the initial procedure in manufacturing beads.

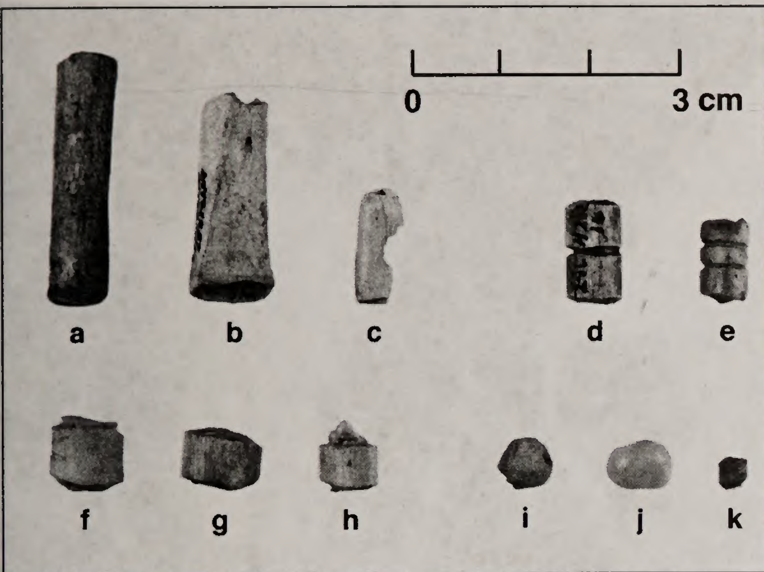



**Figure 32.** Finished, possibly finished, and unfinished bone beads (a-k).

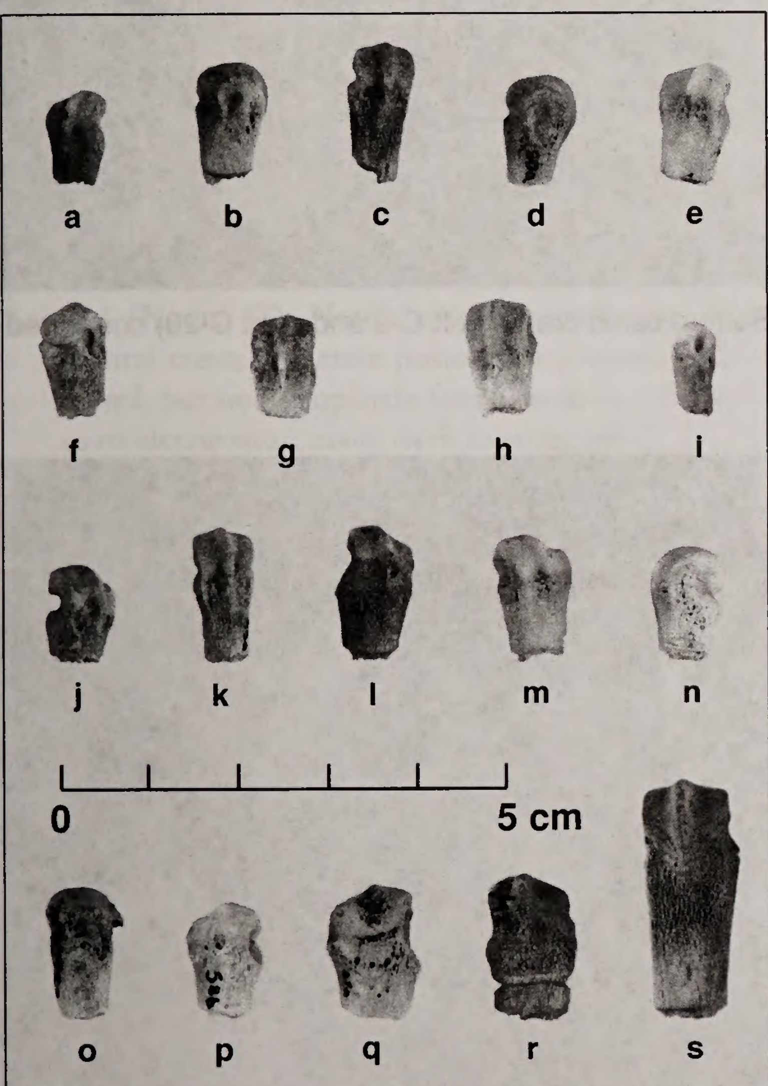



**Figure 33.** Girdled and snapped distal ends of canid metapodials: coyote-sized (a-h, j-k); wolf/dog-sized (q-s); fox-sized (i); indeterminate (l-p).

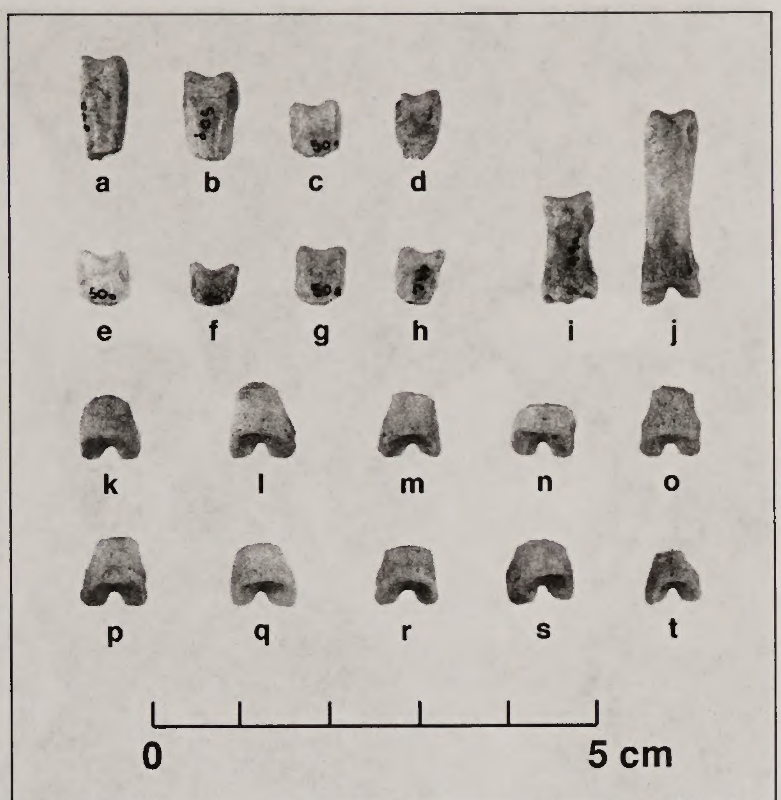



**Figure 34.** Canid 1st phalanx (i), distal end (a-h); proximal end (k-t); complete unworked 2nd phalanx; and complete, unworked 1st phalanx (j).

## Coyote-Sized Crania and Mandibles

### (Figures 35-36)

1. C-9 (Figure 35, left). Anterior half of cranium; braincase portions broken away; sutures closed, but not completely; teeth in, some missing, others moderate to heavy wear; crowding of P4 and M1 on both sides; missing all incisors, but right I3 (broken) and left canine and P1.

2. C-6 and C-7 (Figure 36). Complete left and right (C-7) mandibles; all teeth in, with moderate to heavy wear; incisors P1 and M3 missing from both; both fit C-9.

3. C-11. Occipital condyles; greatest breadth of condyles - 34 mm; may fit C-9.

4. C-20 (Figure 35, right). Heavily fragmented cranium; sutures partially closed; sagittal crest developing; teeth in with light wear; many teeth missing, especially on left side; crowding of P4, M1, and M2 on left side.

5. C-17 and C-19 (Figure 36). Nearly complete left and right mandibles; all teeth in, with light wear; incisors missing in both; P1, P3, M2, and M3 missing on right side (C-19); ascending ramus missing above condyles

Figure 35. Dorsal views of coyote-sized crania Thompson Bottom canid crania (left C-9 and right C-20) compared to a modern cranium (middle).

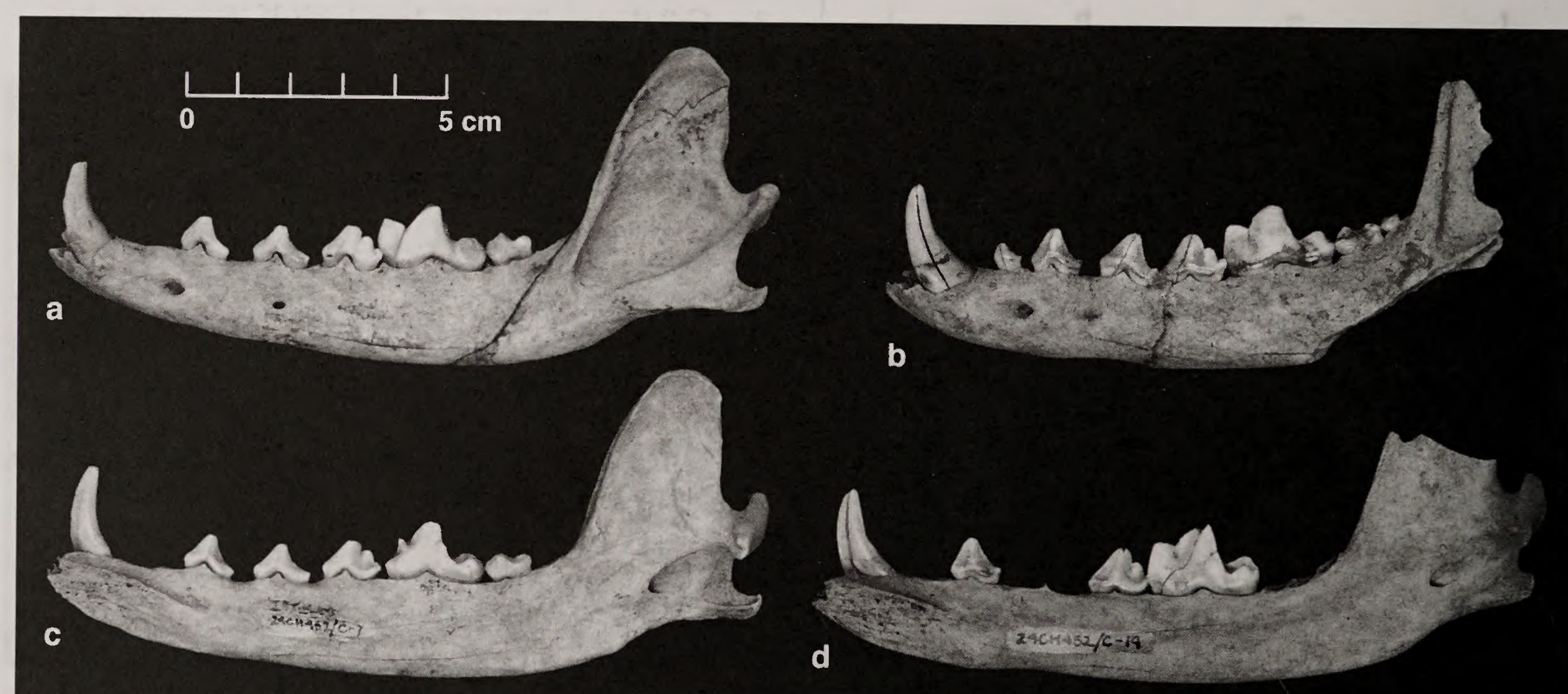



Figure 36. Medial and lateral views of coyote-sized mandibles (a,C-6; b,C-?, c,C-7; and d,C-19).

on both; C-17 has puncture in ramus; both appear to fit C-20. C-17 has a pathological swelling on the lingual surface below M1.

6. C-26 and C-27. Left and right fragmentary maxillae; P4, M1, and M2 present, with light wear; probably from same individual.

In contrast to the coyote skulls, the wolf/dog-sized canid skulls tend to be much more intact. Three complete or nearly complete skulls with corresponding mandibles from individuals ranging in age from advanced subadult/young adult to older adult are present. Age groupings are based on tooth wear and stage of suture closure. A fourth, older adult skull is represented by the posterior portion of the cranium. Five additional mandibles are present from four individuals ranging in age from subadult/young adult to older adult. Assuming that the partial skull is from one of the four individuals represented by mandibles, an MNI of seven individuals is represented.

## Wolf/Dog-Sized Crania and Mandibles

### (Figures 37-43)

1. C-1 (Figure 37). Nearly complete skull; very little sagittal crest; moderate postorbital process; sutures closed, but not completely fused; teeth in, with light to moderate wear; many teeth missing; left I2, I3, P4, M1, and M2 present with light wear; right P4 broken, M1 and M2 present, with light wear; some crowding of right P4, M1, and M2; right premaxilla missing; left dorsal maxilla broken near nasal; right zygomatic arch broken and missing; left zygomatic/maxillary suture pathological; some interorbital tooth-scoring; nasals broken, but still present.

2. C-2 (Figure 38b) and C-3 (Figure 40a). Complete right and left mandibles; all teeth in, with light wear; incisors and P1 missing on both; both from C-1. C-2 has a pathological porous bone growth on the lingual side of the ventral border below M2 and M3; tooth-scored.

3. C-13 (Figure 39). Complete cranium; well-developed sagittal crest; well-developed postorbital processes; sutures totally closed; teeth in, with moderate wear; incisors and right P1 and P3 missing; right P3 socket almost completely resorbed, with some extra, external bone growth and a root fragment still present; some crowding of P4, M1, and M2 on both sides; nasals missing and dorsal maxilla broken and missing.

4. C-5 and C-15 (Figure 40). Complete left and right (C-15) mandibles; all teeth in, with moderate to heavy wear; most incisors missing, right M1 broken (recent), and right M3 missing; heaviest wear on right I3, canines and molars; some additional bone growth on gonions.


Figure 37. Left lateral view of wolf/dog cranium (C-1).


**Figure 38.** Lateral (a) and medial (b-c) views of canid mandibles (a, C-17; b, C-2; and c,C-?).

5. C-23. Partial cranium; posterior portion of cranium; breaks through parietals and basioccipital; well-developed sagittal crest; sutures closed; some tooth-scoring; greatest breadth of occipital condyles is 49 mm.

6. C-66 (Figure 41). Nearly complete cranium; sagittal crest present, but not fully developed; sutures not well fused; all teeth in and present with light wear; left P1 is absent, lacks any cavity so never was present; slight overlap and crowding of P4, M1, and M2 on both sides; left zygomatic arch and temporal bones broken and missing; portion of right zygomatic arch broken and missing; slight boney spur on dorsal surface of left parietal.

7. C-67 and C-68 (Figure 42a). Complete left and right mandibles; all teeth in with light wear; incisors missing, right P1 was never present; not completely ossified, probably younger individual; both fit C-66. C-68 (right) ramus has break that matches the temporal/zygomatic break on C-66.

8. C-24 (Figure 43a). Complete left mandible; all teeth in and missing all or most of I1, I2, P1, P3, and P4; moderate wear on teeth present; slight crowding; some additional bone growth on gonion.

9. C-25 (Figure 43b). Nearly complete right mandible; all teeth in and missing incisors and canine; moderate to heavy wear; slight crowding of molars; ascending ramus snapped above condyle; heavy growth on gonion; largest mandible in sample.

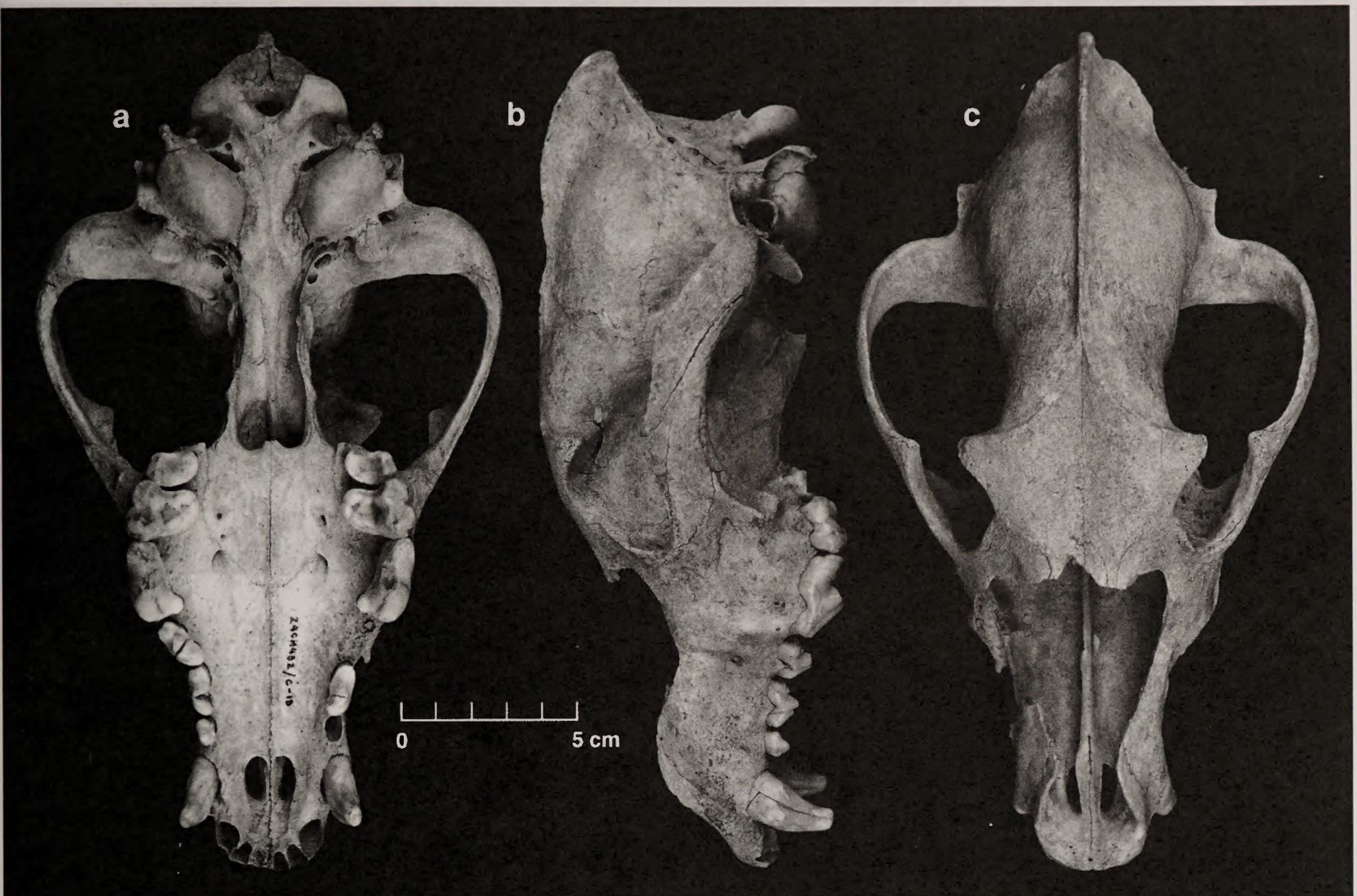
10. C-29. Nearly complete right mandible; all teeth in, but only P4 still present; light wear; probable crowding of P4 and molars; not completely ossified, probably younger individual.

11. C-64 (Figure 42b) and C-65. Complete left (C-64) and right mandibles; all teeth in, but many missing; moderate to heavy wear; crowding; additional boney growth on gonion; both appear to be from the same individual.

The fox/small canid category is represented by post-cranial elements assignable to a single individual (see Table 19).

Measurements for the three complete or nearly complete crania and a total of 15 complete or nearly complete mandibles were taken (Tables 21-24) for comparison with previously recorded data. In comparing measurements of the three crania (Table 22) to known or proposed wolf, wolf/dog, and prehistoric dog hybrids (Haag 1948; Walker 1980; Walker and Frison 1982; Wilson 1983a), I-6 and 1-9 fall within the hybrid range. The remaining measurements appear to fit within either the wolf or hybrid-size range.

Certain of the ratios of mandible measurements (Table 23) and measurements of mandibles (Table 24) from Thompson Bottom canids display bimodal distributions. It is assumed that the smaller ratios and measurements represent coyotes, while the larger are wolf/dog hybrids. Comparing these data to those presented by Walker (1980:Table 30), there is some support for these conclusions. Walker's ratios of measurements for known *Canis lupus* (wolf), *Canis latrans* (coyote), and *Canis familiaris* (dog) all overlap. In comparing the ratios in Table 5 for the smaller mandibles with Walker's data, there is good fit with coyote and dog, with overlap into the low end of the wolf ratios. However, Walker did suggest that Ratio IV (Table 5) might be the most valid way to distinguish dogs from wolves. The shortening of the snout in dogs is reflected in a higher ratio. For Thompson Bottom, the best fit is with domestic dogs or wolf/dog hybrids, with some overlap into the wolf ratios.



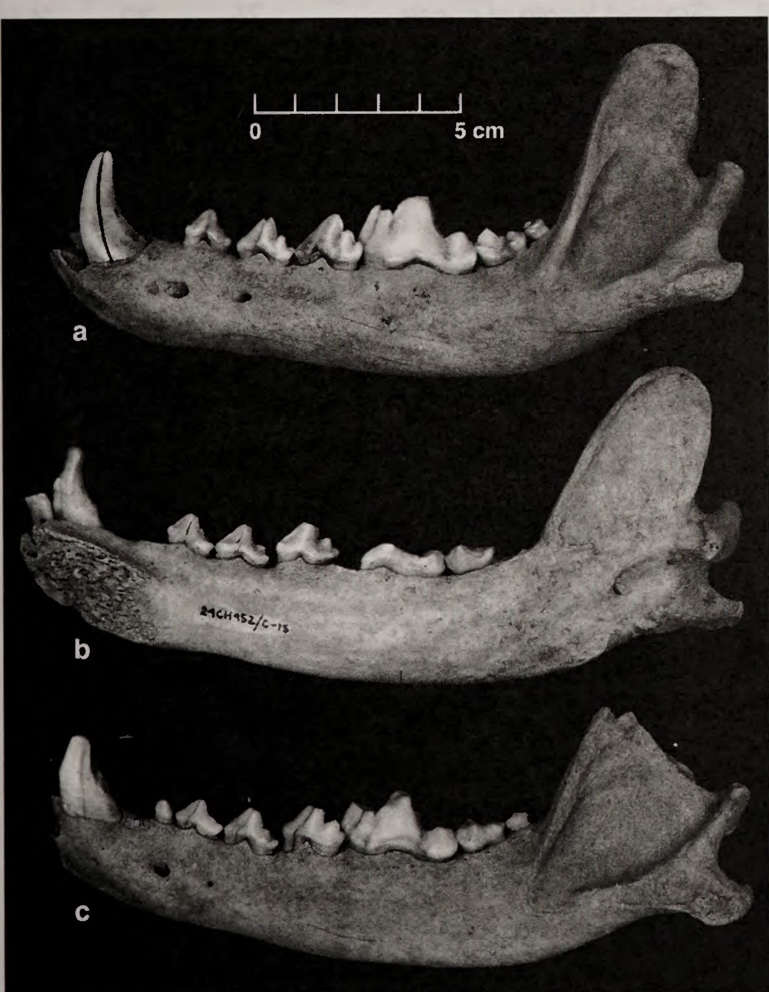




**Figure 39.** Ventral (a), lateral (b), and dorsal (c) views of wolf/dog cranium (C-13).

**Figure 40.** Lateral and medial views of wolf/dog mandibles (a, C-3; b, C-15; c, C-5).

What might be more helpful in determining the species or variety of canid present is a series of non-metric observations taken from crania, as suggested by various investigators (Frison et al. 1978; Lawrence 1967; Walker 1980). These authors aver that features attributable to domestic dogs include intentionally broken teeth, particularly canines; heavily worn teeth (at least partially as a result of the intentional breakage); and a shorter snout. The adult and older adult crania and mandibles where most teeth are present display some crowding and some shortening of the snout, lending support to the conclusion based on the mensural data that the large-sized canid population was probably hybrid. There is, however, no indication that the Thompson Bottom animals were domesticated, based on the attributes listed above.

Among the canid remains are a number of anomalies and pathologies, particularly in the crania and mandibles.


**Figure 41.** Left lateral view of wolf/dog cranium (C-66).

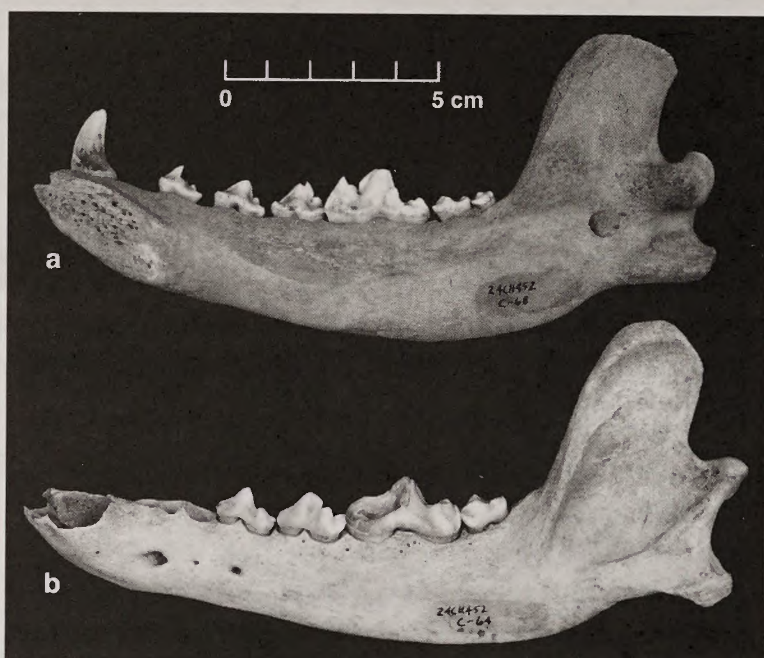



**Figure 42.** Medial (a) and lateral (b) views of wolf/dog mandibles (C-68 and C-64, respectively).

As noted in crania and mandible descriptions, bone-swelling, calcium deposits, or improper suture closure occur on two mandibles (C-17 and C-2) and a cranium (C-1). One cranium has antemortem tooth loss (C-13) and the socket had nearly refilled with bone. One cranium (C-66) and the matching mandible (C-68) are missing the right first premolar, which was never present.

Tooth breakage and resultant loss, bone-swelling, and calcium deposits may be explained by the bone-crushing adaptation discussed by Wilson (1983a) in regard to extreme tooth wear. However, other environmental stresses as well as restricted gene flow could explain the pathologies as well as the anomalous missing teeth.

**Table 21.** Measurements of Large Canid Crania.

| Standard Measurements[a] | C-13 | C-1 | C-66 |
|---|---|---|---|
| 1. Greatest length of cranium | 232 | 216 | 220 |
| 2. Condylobasal length of cranium | 213 | 208 | 200 |
| 3. Basal length of cranium | 202 | 196 | 188 |
| 4. Greatest length of nasals | 75 | 80 | 74.5 |
| 5. Length of snout | 102 | 98 | 90 |
| 6. Length of palate | 116 | 110 | 102 |
| 7. Length of upper carnassial | 23 | (24) | 22 |
| 8. Greatest breadth of mastoids | 73 | 74 | -- |
| 9. Greatest breadth of occipital condyles | 42.5 | 45 | 41 |
| 10. Greatest breadth of cranium | 67 | 64 | -- |
| 11. Breadth of zygomatic arch | 127 | -- | -- |
| 12. Least breadth of postorbital constriction | 41 | 41 | 41 |
| 13. Breadth of frontals | 65 | -- | -- |
| 14. Least interorbital breadth | 47 | 41 | 39 |
| 15. Greatest breadth of palate | 71 | 73 | 68 |
| 16. Occiput to nasion length | (140) | 115 | 117 |
| 17. Cranial height | 61 | 59 | 55 |
| 18. Meatus to alveolus I1 length | 178 | 173 | 162 |
| 19. Length from I1 to M2 | 109 | 112 | 100 |

[a] After Haag (1948), Walker and Frison (1982), and Wilson (1983a); numbers in parentheses represent close estimates.

The only postcranial pathology is a single incidence of osteoarthritis observed on a coyote-sized metacarpal. This pathology may have resulted from a break or bruise.

In summary, the Thompson Bottom sample includes

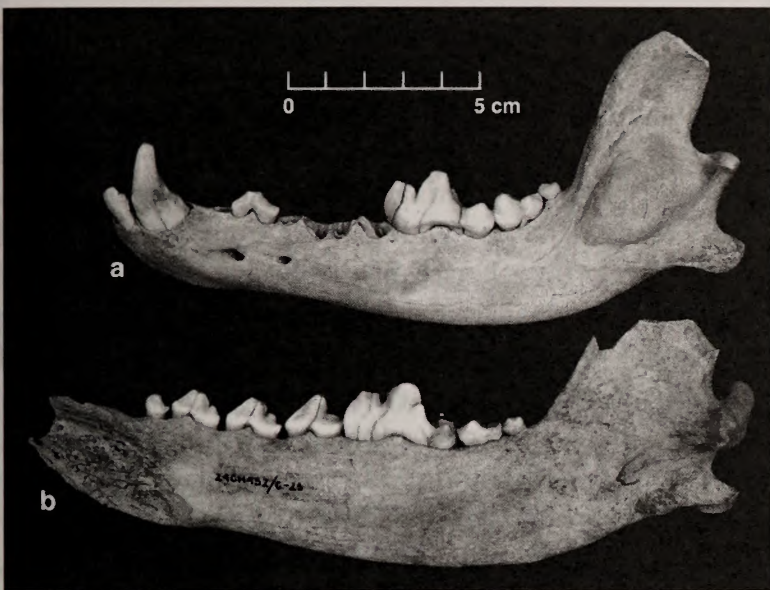



**Figure 43.** Left lateral (a) view of wolf/dog mandible (C-24) and right medial (b) view of wolf/dog mandible (C-25).

**Table 22.** Ratios Expressing Canid Mandibular Proportions.[a]

| Thompson Bottom Coyote-Sized | I | II | III | IV |
|---|---|---|---|---|
| C-6 | 42.5 | 40.0 | 14.0 | 24.2* |
| C-7 | -- | -- | 14.0 | 23.5 |
| C-17 | 50(est.) | 40.0 | -- | 27.4* |
| C-19 | 48.8 | 39.0 | -- | 27.8 |
| **Thompson Bottom Wolf/Dog-Sized** | | | | |
| C-2 | 53.7 | 51.9 | 17.4 | 33.7* |
| C-3 | 53.7 | 51.9 | 17.1 | 34.0 |
| C-5 | 49.1 | 41.8 | -- | --* |
| C-15 | -- | -- | 14.4 | 30.2 |
| C-24 | 48.2 | 42.9 | 15.2 | 32.6 |
| C-25 | 48.3 | 37.9 | -- | -- |
| C-29 | -- | -- | 16.2 | -- |
| C-64 | 48.1 | 40.7 | 13.8 | 28.4* |
| C-65 | 46.3 | 40.7 | 13.8 | 29.5 |
| C-67 | 54.1 | 51.3 | -- | 33.8* |
| C-68 | 53.1 | 51.0 | 17.1 | 34.2 |

I = Latero-medial width of jaw below M1:crown length of M1
II = Latero-medial width of anterior base of ascending ramus:crown length of M1
III = Latero-medial width at anterior base of ascending ramus:height of ascending ramus parallel to posterior margin
IV = Minimum latero-medial width (taken at right angles to symphysial surface and posterior to canine) and alveolar length from I1 to posterior border of P2
[a]From Lawrence (1968).
*Same individual.

a minimum of 11 canids, which are categorized as one fox-sized, three coyote-sized, and seven wolf/dog-sized individuals. One bone is tentatively identified as a small canid baculum, indicating that the fox-sized individual is male. Otherwise, no sexual indicators are apparent. All skeletal elements are at least minimally represented at the site, indicating that, if the canids were skinned, some were skinned at the site. The method of killing some of the larger animals appears to have been by a blow across the snout or to the side of the skull. Two of the wolf/dog-sized skulls had been broken and/or are missing nasals, while substantial breakage had been inflicted to the zygomatic region of two wolf/dogs. The presence of chewed canid bones might be explained by carnivore-scavenging after the site was abandoned. An alternative explanation is the possibility that wild canid remains were fed to hybrid canids. While no evidence confirms the presence of domesticated dogs, measurements and observations of the large-sized canid skulls and mandibles indicate that they derive from hybrid populations.

**Table 23.** Comparative Canid Mandibular Measurements (mm).

| Thompson Bottom Coyote-Sized | I | II | III | IV |
|---|---|---|---|---|
| C-6 | 8 | 15 | 8 | 2.5* |
| C-7 | 8 | 15 | 8 | 2 |
| C-17 | 10 | 13 | 8 | 3* |
| C-19 | 10 | 12 | 8.5 | 3 |
| **Thompson Bottom Wolf/Dog-Sized** | | | | |
| C-2 | 12 | 10 | 10 | 4* |
| C-3 | 14.3 | 11 | 10 | 4 |
| C-5 | 13 | 16 | 10 | 4* |
| C-15 | 13 | 17 | 10 | 4 |
| C-24 | 14 | 14 | 11.2 | 4 |
| C-25 | 15 | 18 | 11.2 | 5 |
| C-29 | 12 | 14 | 11.5 | 4 |
| C-64 | 12.2 | 16 | (11.5) | --* |
| C-65 | 13 | 16 | 12 | 4 |
| C-67 | 13 | 12.0 | 8 | 4* |
| C-68 | 13 | 11 | 8 | 4 |

I = Minimum latero-medial width at symphysis posterior to canine
II = Alveolar length from back of canine to middle of P2
III = Alveolar length of P2
IV = Alveolar width of P2
[a]From Lawrence (1968); numbers in parentheses indicate close estimates.
*Same individual.

## Bone Beads and Bead Production Debitage

*Marc B. Smith and John W. Fisher, Jr.*[1]

The excavation at Thompson Bottom yielded a total of 75 bone specimens that represent bone bead production "debitage" (byproducts), unfinished beads, and finished beads (Table 20; Appendix B). The majority of these specimens are debitage. Finished beads are represented by at least two, and possibly as many as eight, specimens. All specimens identifiable taxonomically are canid. Most debitage specimens retain one articular end (either the proximal or the distal end of the bone), and are identifiable as canid and to skeletal element. We presume that the specimens not identifiable taxonomically (including finished beads, which lack anatomically diagnostic features for identification taxonomically or to specific skeletal element) likewise derive from canids. The Thompson Bottom canid crania and mandibles were identified by Greiser (this volume) as coyote (*Canis latrans*), large canid (wolf /dog) (*Canis* sp.), and fox-sized canid (cf. *Vulpes* sp.) Some specimens are identified as coyote-sized, wolf-sized, fox-sized, or indeterminate canid (Appendix B). The taxonomic and skeletal element identifications reported here (Table 20) and in Appendix B are by Greiser.

Four canid skeletal elements were used as raw material for beads: metacarpals, metatarsals, first phalanges, and ulnae. These bones have a tubular, hollow diaphysis (shaft) that lends itself readily to the manufacture of tubular bone beads. Creation of tubular beads appears to have been accomplished by "girdling" the shaft of complete bones with an incision, and snapping the bead away at the incision to remove one epiphyseal end (articular end) of the bone. Semenov (1964:152-153) reproduced this process experimentally using a small stone bladelet. This procedure was repeated at the opposite end of the bead to remove the opposite epiphysis, creating a tubular section of diaphysis. More than one bead could be made from bones that had a sufficiently long length of diaphysis. The majority of debitage specimens have little adjoining shaft, suggesting removal of multiple beads until the diaphyseal portion of the bone had been largely exhausted.

The ulna specimens display fine longitudinal striations. Striations are concentrated along bone ridges and muscle attachment areas. They appear to have been imparted by a flaked stone tool rather than a sandstone abrading tool, given the fineness of the striations. The purpose of the action that created these striations is unclear. Similar striations are present on some finished beads (especially those having a larger diameter or having a greater length).

Exterior modifications of beads vary with the general shape of the bead, with shorter beads receiving the majority of secondary-shaping. The longer beads show only minor cleaning of the incised-and-snapped ends, with the original cut marks still readily visible. One short, spherical bead exhibits coarse abrasive striations over the entire exterior surface. These striations are distinctly different from the fine striations observed on other specimens. Those beads considered to be finished exhibit varying degrees of polish. The polish is assumed to be a result of use, although it could have been imparted, at least in part, during the manufacture of the beads. Two of the longer beads exhibit shallow lines incised transverse to the long axis of the bead. These might be decorative elements.

[1]This section presents a distillation by Fisher of an analysis of the Thompson Bottom beads and bead production debitage conducted by Smith and written up by him in a brief, unpublished report many years ago. Smith's analysis included examining specimens using a 10-40X binocular microscope. Unfortunately, metrics on the beads and bead debitage are not available, and recent attempts to borrow the beads and debitage from the owner so that they could be measured and re-examined were unsuccessful. We are grateful to T. Weber Greiser for his identification of these specimens taxonomically and to skeletal element (see Appendix B).

# Geochronology and Cultural Affiliation

*Leslie B. Davis*

The abundance of tightly provenienced organic remains such as wood charcoal and collagen from unburned bone (bison and canid) presented an opportunity to obtain conventional radiocarbon ages (Table 24). Five dates range in age from 1,165 ± 80 to 775 ± 80 B.P. Excluding, I-7029, the remaining four ages range from 530 ± 50 to 275 ± 80 B.P., averaging 380 ± 80 B.P., or a range of 460 to 300 B.P.

Of lesser inferential importance are the associated $^{12}C/^{13}C$ ratio measurements. Ratios for bison bone range from -20 to -25, averaging 21.25. The single canid bone measurement is -23.8.

The five obsidian flakes (2040 to 2047) sourced by x-ray fluorescence are attributed to the Obsidian Cliff Plateau in Yellowstone National Park (Table 25). Distribution northeastward by mobile people during Late Precontact Period times is an established pattern.

A different series (n=16) of obsidian artifacts (D3802 to D3824) (Table 26) was thin-sectioned to enable hydration-age measurement. Hydration rind thicknesses range from 1.13 to 1.40 μ, averaging 1.50 μ. Application of a hydration rate of 3.83 $\mu^2$/1,000 years B.P. led to the derivation of 15 hydration ages, ranging from 333 to 572 years B.P., and averaging 406 years B.P.

Reference to the discussion above regarding analysis of data in Table 25 shows a range of 300 to 460 years B.P. The average for radiocarbon ages of 380 ± 80 compares well with 406 hydration years B.P. Such agreement supports the use of multiple instrumental procedures to approximate time elapsed since Late Precontact events and activities.

**Table 24.** Radiocarbon Ages from Thompson Bottom Proveniences (Davis and Aaberg 1978; Davis 1981; see also Appendix C).

| Provenience | Sample Number | Organic Material | $^{14}C$ Lab # | Conventional $^{14}$Age B.P. | $^{12}C/^{13}C$ Ratio |
|---|---|---|---|---|---|
| | TB-97-1 | unburned canid bone (collagen) | Beta-105645 AMS(LLNL) | 530 ± 50 | -23.8 |
| | | unburned bison bone (collagen) | I-7029 | 1,165 ± 80 | -25 |
| .9 m b.s | .4a | wood charcoal | I-8940 | 275 ± 80 | -20 |
| 1.7 m b.s. | 3 | unburned bison bone (collagen) | I-8941 | 340 ± 80 | -20 |
| 1.3 m b.s. | 4 | unburned bison bone (collagen) | | | |
| 2.05 m b.s. | 0S-3 | unburned bison bone (collagen) | RL-820 | 370 ± 100 | -20 |

Excavation provenience, material culture and animal remains analyses, and age-dating have laid a firm foundation for human behavioral inference and interpretation. We will now integrate those findings so that meaning inherent and implicit in those treatments can be both extracted and interrelated in a culture-ecological framework.

**Table 25.** X-Ray Fluorescence Element Geochemistries and Source Determinations for Obsidian Artifacts (after Hughes 1989a,b; Davis et al. 1995: Appendix E).

| Obsidian Artifact | Cultural Affiliation | Cultural Period | Specimen Number | Zn | Ga | Rb | Sr | Y | Zr | Nb | Geological Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Element Concentrations | | | | | | | |
| flake | Late Plains | Late Precontact | 2040 | 100 ±8 | 26 ±4 | 268 ±6 | 3 ±3 | 86 ±3 | 167 ±5 | 46 ±4 | Obsidian Cliff Plateau |
| flake | Late Plains | Late Precontact | 2041 | 88 ±6 | 22 ±3 | 266 ±5 | 2 ±3 | 87 ±2 | 172 ±4 | 51 ±4 | Obsidian Cliff Plateau |
| flake | Late Plains | Late Precontact | 2045 | 74 ±6 | 18 ±3 | 246 ±5 | 0 ±18 | 82 ±2 | 164 ±4 | 45 ±4 | Obsidian Cliff Plateau |
| flake | Late Plains | Late Precontact | 2046 | 87 ±6 | 23 ±3 | 254 ±6 | 2 ±3 | 88 ±2 | 165 ±4 | 49 ±4 | Obsidian Cliff Plateau |
| flake | Late Plains | Late Precontact | 2047 | 86 ±6 | 27 ±3 | 247 ±6 | 4 ±3 | 83 ±2 | 172 ±4 | 46 ±4 | Obsidian Cliff Plateau |

**Table 26.** Obsidian Hydration-Derived Chronometric Ages of Obsidian Artifacts (after Davis 1976: Table 2).

| NW Plains Number | POD Lab Number[1] | Excavation Provenience | Hydration Value (in μ)[2] | Hydration Age[3] (in years B.P.) |
|---|---|---|---|---|
| D3816 | M1893 | A-1SOW/15-30 | 1.13 | 333 |
| D3818 | M1895 | A-1SOW/15-30 | 1.13 | 333 |
| D3819 | M1896 | A-0S2W/0-20 | 1.15 | 345 |
| D3813 | M1890 | A-0S2W/10-20 | 1.16 | 351 |
| D3821 | M1898 | A-0S2W/0-20 | 1.18 | 364 |
| D3823 | M1900 | A-WX | 1.21 | 382 |
| D3811 | M1888 | A-0S2W/0-20 | 1.21 | 382 |
| D3810 | M1887 | A-WX | 1.32 | 455 |
| D3805 | M1882 | A-0S2W/0-20 | 1.33 | 462 |
| D3802 | M1879 | A-1S1W/15-30 | 1.33 | 462 |
| D3807 | M1884 | A-1S1W/15-30 | 1.34 | 469 |
| D3803 | M1880 | A-0S2W/0-20 | 1.37 | 490 |
| D3817 | M1894 | A-1S0W/15-30 | 1.41 | 519 |
| D3814 | M1891 | A-0S2W/10-20 | 1.46 | 557 |
| D3804 | M1881 | A-0S2W/0-20 | 1.46 | 557 |
| D3824 | M1901 | A-WX | 1.48 | 572 |
| | | | **Mean μ=1.42** | **Mean Age: 440 B.P.** |

1 Pennsylvania Obsidian Dating Laboratory control number; the M is for (Nancy) Marshall.
2 The hydration rind thickness is recorded here in microns rounded to the nearest hundredth of a micron.
3 A rate of hydration of 3.83$\mu^2$/1,000 years B.P. (Davis 1972), derived for the Central-Southern Plains Sub-region, was adopted to enable hydration age-dating.

# Late Precontact Dog-Days at Thompson Bottom

*Leslie B. Davis*

## Introduction

All of Plains Precontact time and events and developments in aboriginal North American life transpired during the "Dog Days," when they preceded the advent, adoption, and widespread use of the horse (Brink 1986) on the Plains ca. A.D. 1720, or ca. 230 years B.P. Ewers (1955, 1960) and others (Wissler 1914; Wilson 1924; Secoy 1953; Roe 1955; Haines 1938) thoroughly describe the behavior of Plains-adapted peoples of the Equestrian Era. While there are still considerable differences of opinion among anthropologists regarding the swiftness and behavioral significance of the horse for Plains aboriginal societies (see Osborn 1983 for a full discussion). For instance, Ewers (1955:331) states that, "Their experience with dogs as transport animals prepared the Plains Indians for acceptance of the horse as a stronger and more useful 'big dog' which would relieve them of carrying heavy burdens and expedite buffalo hunting." Further, Ewers (1955:339) asserts that,"It appears to me that the influence of the horse permeated and modified to a greater or lesser degree every major aspect of Plains Indian life."

Osborn (1983:585), in criticising anthropologists, notes that, "The transition from pedestrian dog-using foragers to equestrian hunters has been seen as an abrupt, complete 'culture change'.... Many significant aspects of aboriginal life, including group size, mobility, technology, food getting, settlement systems, and socioeconomic/ sociopolitical organization, can be casually linked to horse herd size(s) and horse-to-person ratios."

In any case, we are here interested in an adaptation achieved prior to entry of horses onto the Thompson Bottom scene. The difficulties of winter feeding along with the associated practice of acquiring cottonwood bark for horse forage could have delayed arrival of horses there (see White 1982).

Economic advantages were conferred on those owning horses, not the least of which was an enhanced ability to transport their villages, hunters, family members, and procured game over considerable distances rapidly. Those who possessed many horses were accorded rank and status. Militarism developed among peoples previously engaged in amiable trading and social interaction. The size of lodges, or tipis, and number of inhabitants increased to accommodate larger co-resident populations. Petroglyphs symbolic of and representing early horse culture appear as panels downriver at the Hoffer occupation site (see Figures 51-56 in Davis et al. 1989 and S. W. Conner, *Prehistoric Horse Petroglyphs (24CH757) in Eagle Creek Canyon*, pp. 99-111).

By contrast, lifeways in the Northwestern Plains prior to A.D. 1720, or more than two centuries ago, were limited to pedestrian mobility involving and dependent upon use of dogs and dog/wolf hybrids as essential "beasts of burden." Canids transported possessions and other materials from one camp to the next. In effect, the canine-pedestrian hunting strategy became traditional.

## Mobility and Subsistence

Ca. two to three radiocarbon centuries ago, likely during late summer, in anticipation of another long, hard winter, pedestrian big-game hunters and families departed a camp site where their food supply had been depleted, transporting dwellings (tipis), possessions, food, and, possibly fragile elders, by dog/wolf/dog traction to a river bottom along what is today the right bank of the upper Missouri River, to a special place we here call Thompson Bottom. We assume that adult-sized, large canids pulled travois-like sleds loaded with bison skin-covered pole lodges, and hide covers, clothing, footwear, tools, weapons, and other domestic and utilitarian goods and supplies. At other times, dogs hauled firewood, meat, and other supplies on long-range hunts, sometimes pulling a dog-sized travois. Bison (*Bison bison*) were available here in numbers sufficient to sustain the band or bands to support the families. Also collectible nearby, but in fewer numbers and of less nutritional value, were water creatures (freshwater mussels), lesser mammals (porcupine, beaver), and ungulates (wapiti, pronghorn) adapted to sage brush-grasslands, drawn here to the life-giving, perennially available water of the river, called by the Assiniboine, "Big River."

Hunters were equipped with bows and arrows they employed effectively close-up to kill trapped game and at longer distances in diverse encounter-hunting situations. A few kilometers upstream, also on the right bank of the river, archaeologists found and minimally recorded sets of converging stone piles (site 24CH81) (Figure 14), constructed by people to guide, direct, and entrap herds of bison by driving them off a cliff and down a decline, perhaps into the flowing water where they could be dispatched. The

carcasses were then dragged up onto the terrace, butchered and the meat processed, cooked, and consumed near or at Thompson Bottom. Bone scrap and innards discarded nearby likely attracted ravenous carnivores to scavenge the remains, including gangs of wild canids that mingled with and mated with dogs.

## Settlement

While no evidence of habitation was excavated at Thompson Bottom, tipi ring sites (24CH216: n=3 and 24CH20: n=9) (Figure 46), family residences, occur headward of the drive lines and lanes mentioned above (Figure 15) as well as nearby. At slightly higher elevation to the southeast is another cluster of four tipi rings (24CH23) (Figure 15). Since none of these 16 domiciliary features were mapped in detail or excavated, their antiquity, size, potential bioarchaeological content, and number of occupants of each dwelling cannot be known; excavation and allied studies would be required.

Adequately studied, some tipi ring encampments have yielded essential information regarding age(s) of occupation and the archaeological identity of the tipi dwellers, e.g., at the Pilgrim occupation site (24BW675) (Aaberg 1980, 1983; Davis 1983, 1985; Davis et al. 1980) in the west-central Montana Rockies. There, it was learned that two independent phases were represented by several of the excavated tipi rings: Pelican Lake and Late Mountain Plains. Also, radiocarbon dates on charcoal and bone discard confirmed phase assignments made on the basis of projectile point typology.

To the west, upriver, where Big Sandy Coulee (Figure 6) drains into the Missouri from the north, 20 tipi rings, situated on prairie uplands (site 24CH211), were casually mapped, but none excavated (Davis 1976:33, Fig. 16). Limited fieldwork at this largely undisturbed (except for cattle-trampling) habitation site nevertheless stimulated development of a tipi ring mapping device by Marc Smith (1974) (**Tipi-Quik**) that has since been adopted by archaeologists, with modifications, specifically at the Middle to Late Precontact Pilgrim site mentioned above, as an efficient and accurate two-dimensional mapping instrument.

Historic estimates suggest that seven to 12 dogs were kept per lodge, although other counts have 12 or more dogs per lodge, which could suggest 250 to 1,000 dogs per tipi village in the best of times (Bozell 1988:97).

## Canine-Pedestrian Cultural Strategy

Relationships between hunter-gatherers, "domesticated" dogs (large and small varieties), and wild canids such as wolf/dogs, wolves, coyotes, and foxes were complex. Wolves, coyotes, and foxes could not be tethered and worked, but rather, instead, provided meat and hides, as desired, in the best of times and, more importantly, the worst of times. Dogs and wolf/dogs were key elements in the work force. For instance, the pre-horse Pawnee kept a "large force" of strong dogs "which functioned as a key element in tribal subsistence networks" and provided a secondary food source in times of dietary stress" Bozell (1988:95). However, Pawnee dog culture diminished after adoption of the horse.

*Dogs were eaten both as a staple food source during lean years or seasons and as a component of ceremonial or medicinal practices. Pawnee feasting episodes, with dog and other meat served as documented.... Murie (1981:166) described the use of dog meat by Pawnee medicine men during healing rituals.*

Although more traditional studies have emphasized the seasonally predictable movements and whereabouts of bison, it remains that dramatic, sometimes seasonal, fluctuations in short-term bison availability did occur locally on varying scales. During such times, resort to eating dogs (read "canids") for dietary support would be critical:

*No one has ever suggested that one of the significant functions of Plains dogs in pedestrian days was to bridge the low points in bison fluctuations. If such was the case, the dog supply would have had crucial adaptive significance, in at least late pedestrian societies (Thurmann 1988:167)....*

White (1955:170) observed "that dogs might have served as 'emergency rations' in some circumstance, as "during a severe blizzard...," or during a siege. In any case, canids provided an essential dietary substitute, if not of equivalent nutrient value, during late winter and spring when ungulate herds were at greatest risk of starvation and scattered. Native Americans occasionally endured near-starvation because of the long, harsh winters.

Reliance on lean meat could cause serious health consequences.

*It is highly possible....that on the North American Plains, an area of extreme seasonality, dogs may have also provided a dependable source of a nutrient other than protein. Ethnographic accounts emphasize that dog meat was considered as a palatable food and that the fattiness of dog meat was highly valued (Snyder 1991:370).*

*Snyder concludes her assessment of dogs as a subsistence resource in the Plains by noting that, evidence 'suggests that these numerous, readily available, efficient scavengers may have*

*been an important element of subsistence, particularly during certain times of the year.' Also numerous reports document the apparently widespread practice of dog feasts, as well as the palatability and fatness of dogs which were specially fed for such purposes.... These sources also document the scarcity and poor condition of game during the winter through late spring, and that dogs often provided alternative meat resources, sometimes heavily exploited, during these seasons (1991:373-375).*

## A Local Subsistence Analogue for Bison Seasonal Unavailability

Lost Terrace (24CH68) (see Figure 6 for location) is an occupation site where peoples of the Avonlea Phase butchered, cooked, and consumed more than 80 (newborn and adult) pronghorn antelope (Davis and Fisher 1988, 1990; Greiser 1988; Davis et al. 2000). That only the partial remains of a single bison is represented in the bonebed (the predominant prey species for Avonlea hunters) signifies that bison wintered elsewhere than the river bottom. In what might have been a life-threatening food shortage, the bow-and-arrow-equipped hunters turned their attention and skill to killing river-wintering pronghorns.

Elsewhere, Buchner (1981) invoked the "Anomalous Winter Hypothesis" to account for a shift in prey selection by members of the Oxbow Complex. While wintering on the southern Canadian Plains, and usually heavily dependent on bison, were forced to alter their predation behavior to survive.

The large number and species diversity of canids harvested for food and hides and, secondarily, to obtain foot bones as raw material for bead production, is a departure from what is generally understood regarding Dog-Days lifeways in the west-central Montana High Plains. With the exception of utilized faunal residues recovered from the Bootlegger Trail (24TL1237) site (Roll and Deaver 1978) along the Marias River. Thompson Bottom represents a unique, probably seasonal adaptation. Investigation of Bootlegger, located on the south side of the Marias River, a tributary of the upper Missouri, yielded remains of 18 species, dominated by bison (*B. bison*) remains (90% of analyzed faunal remains) (Roll and Deaver 1978: Table 8). Carnivore species are more numerous and diverse at Bootlegger.

Elsewhere, the archaeological record developed for the Late Precontact Period Bootlegger Trail bison kill/processing site (24TL1237) south of the Marias River and Tiber Reservoir (Lake Elwell) (Roll and Deaver 1980), radiocarbon dated to A.D. 700 to 1,725 (645 ± 80 [I-9205] and 760 ± 80 [I-9204] $^{14}C$ years B.P.) bears numerous similarities to artifactual and faunal species in evidence at Thompson Bottom. Most notable are: pièce esquillées (n=5); earthenware ceramics (n=169 potsherds, 3 vessels); canid bone bead production (Roll and Deaver 1980:142-143), n=24 beads and girdled bone shafts (n=26); and beaver, porcupine, domestic dog, coyote, swift fox, wapiti, pronghorn antelope, bison, and river mussel; 10 food species are represented (Roll and Deaver 1980: Table 8). Absent from Thompson Bottom were remains of deer, grizzly bear, bobcat, hare, and rabbit. Bootlegger Trail activities clearly transpired nearly 1,000 years prior to occupation of Thompson Bottom, thus establishing adaptive precedent and erasing the ostensibly exceptional appearance of the adaptation now so well documented at Thompson Bottom.

It is at the Galata site on the south shore of the Marias River, northwest of site 24CH452, that the most impressive assemblage parallels are evident. At Section 6, about 3 m below terrace surface, Miller (1963:249) found remains of elk, deer, antelope, dog, and wolf in small numbers, mixed with the dominant remains of bison. In Section 7 nearby, butchered bones of elk, antelope, dog, and wolf were found with bison 0.3 m below surface. Tines from both deer and elk antler were used as implements at this multi-component Late Precontact occupation site.

The biologic diversity, as well as differential incidence of utilized canids at Thompson Bottom, is rarely reported from the Northwestern Plains. The most immediately comparable, of reported mixed archaeological canid species series to come to our attention is that from the Vore Bison Jump in northeastern Wyoming (Walker 1975). At this Protohistoric/Late Precontact bison kill site, dated from 440 to 180 B.P., remains of a large number of wolves, some of which Walker suggests might represent incipient domestication, were found.

## A Cautionary Note

It is wise if not essential to characterize Precontact activities in a more reasonable (realistic?) way than is inferrable from the minimizing perspective and effects of Minimum Number of Individuals (MNI) (e.g., Hesse 1982) calculations. Only a small, unknowable fraction of the terrace and the Precontact occupation at the Thompson Bottom site was "sampled" by our excavation. Also, recovery of small artifacts and animal remains, such as bone beads, and possibly molluscs, was biased by the use of 1/4-inch-mesh screens. In view of these considerations, recovered materials are all the more important in generalizing various of the events and activities by human occupants and the roles of carnivores and scavenger species.

On the other hand, the remarkable number of canid bones and teeth recovered from a fractionally small-scale

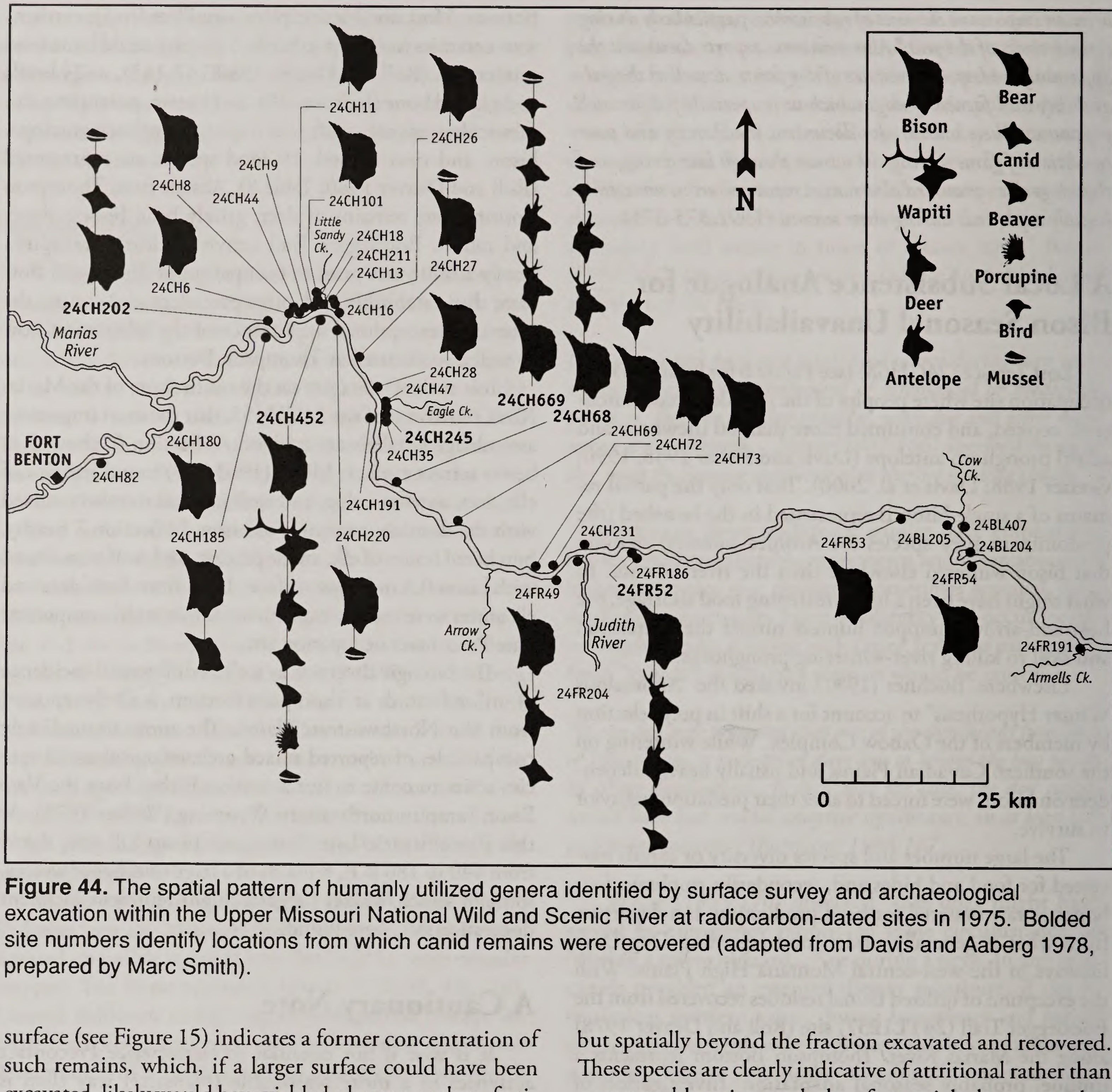



**Figure 44.** The spatial pattern of humanly utilized genera identified by surface survey and archaeological excavation within the Upper Missouri National Wild and Scenic River at radiocarbon-dated sites in 1975. Bolded site numbers identify locations from which canid remains were recovered (adapted from Davis and Aaberg 1978, prepared by Marc Smith).

surface (see Figure 15) indicates a former concentration of such remains, which, if a larger surface could have been excavated, likely would have yielded a larger number of utilized canids and associated bone-bead production behavior. The widespread use of canids was documented during the 1976 reconnaissance by collection of canid bones, mostly mandibles, from four other exposed cutbank sites (Figure 44).

By this reasoning, the few mandibles, teeth, and bones from what appear to be single individuals representing non-bison and non-canid species (wapiti, pronghorn antelope, beaver, porcupine, and prairie dog) must also be somehow biased. Other elements must be available on site surface, but spatially beyond the fraction excavated and recovered. These species are clearly indicative of attritional rather than communal hunting, and, therefore, might be expected to be present in smaller numbers than were the few numerous species.

The variable abundance and species diversity of gatherable subsistence resources in the environs of Thompson Bottom can be imagined by reference to Figure 45. Short distances across adjacent microhabitats presented economic advantages for collecting and hunting. The sustainable richness (abundance plus diversity) of these ecotones enabled occupation of this river-side location for as long as peoples needed to stay there.

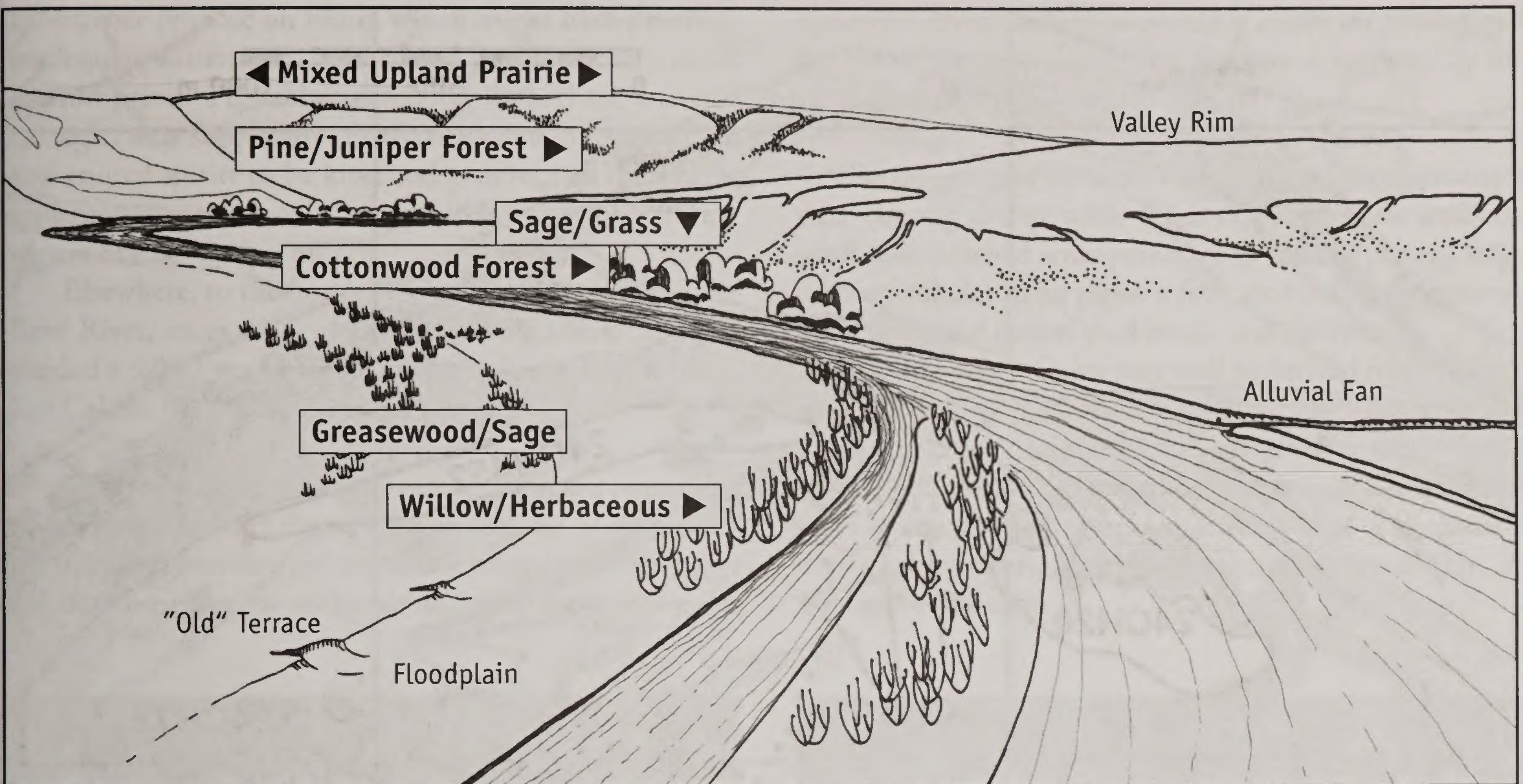



**Figure 45.** Idealized distribution of ecotones that presented a series of discrete Plains-Missouri River subsistence zones to herbivores, predators, and native peoples alike that frequented Thompson Bottom (adapted from Davis and Aaberg 1978, prepared by Marc Smith).

## Ritual Preparation and Conduct Equate With Ceremonialism

Our designation of Thompson Bottom as a ceremonial site was inspired by and largely contingent on manufacture of beads from canid bones. We regard this industry as a signature ornamental/ceremonial activity linked to spiritual observances.

This hypothesis is supported by a local circumstance. Certain of the highly varied artifacts recovered from the Shanahan Cairn (24CH202) a few kilometers upstream, on a knoll overlooking the left bank of the Missouri (Figure 49), are clearly indicative of "ceremony." In 1962, this one of a kind site was the only source (Mallory 1963:15-16) of prehistoric ceramics of which Mallory was aware during his research on the Upper Missouri where he had investigated for the River Basin Surveys (Smithsonian Institution). Richard Hurd, a member of the Milk River Archaeological Society (MRAS) (Havre), obtained an estimate of the dimensions of this feature of four feet in diameter at ground surface and three feet in height before it was impacted and exposed by road-building. Subsequent removal of myriad artifacts by artifact collectors attracted there by news of this remarkable find completed the destruction. Both Hurd and John Brumley (MRAS) (Havre) salvaged artifacts overlooked or discarded by vandals.

Hurd collected 10 fragments of possibly intentionally broken tubular stone smoking pipes (Figure 48); canid, possibly bird, fish vertebra, and mussel shell beads; and drilled, irregular-shaped pebble stone beads (Figure 50). Included in his collection are five small, side-notched and one triangular unnotched arrowpoints (Davis and Aaberg 1976: Fig. 21) and numerous cord-marked potsherds.

Brumley recovered a plethora of canid bone beads, perforated snail shell beads, fish vertebra beads, mussel shell beads, pebble stone beads of irregular shapes, raptor (eagle, hawk-sized) talons, an ammonite septum (an *iniskim* or bison amulet), a bone awl, the articular end of a canid metatarsal involved in bead production, a perforated beaver(?) incisor pendant, and Figure 49, finished and unfinished, polished canid and bird bone beads of varied shapes and sizes. He also recovered cord-marked potsherds.

The brief MSU salvage work in 1975 recovered a small, but informative artifact sample, including the proximal end of an eyed bone needle, finished and unfinished canid bone beads, mussel shell beads, a mussel-shell gorget with two near-edge perforations, and three Late Precontact Period side-notched arrowpoints (Davis and Aaberg 1976: Fig. 24) (Figure 51). A complete, fully-grooved hammerstone, evidently once smeared with red ochre, was also recovered (Davis and Aaberg 1976: Fig. 23). Human remains have not been recovered from the Shanahan Cairn.

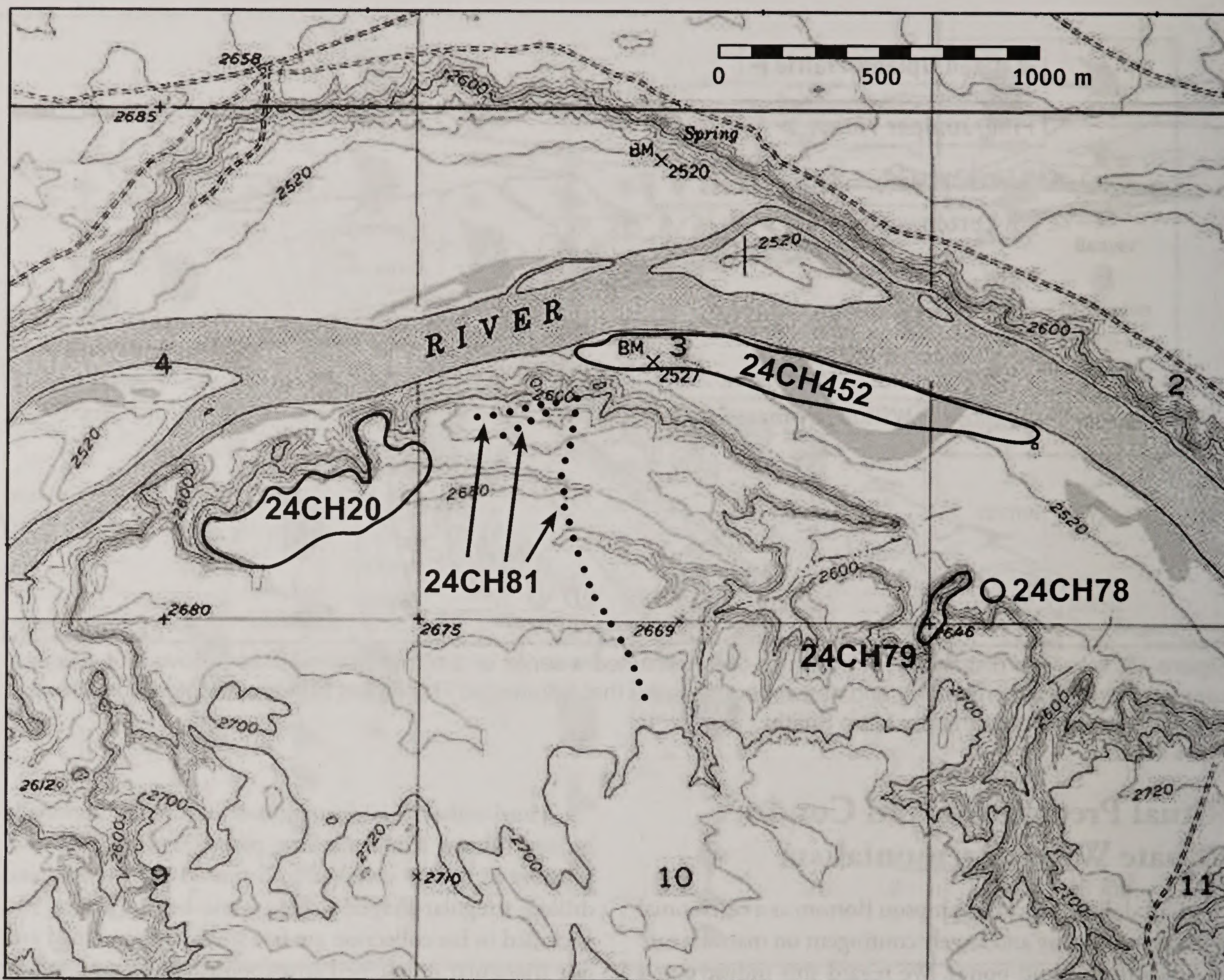



Figure 46. Map locating tipi rings, drive lines, and drive lanes in the near vicinity of Thompson Bottom (adapted from Verona Quadrangle, developed by Eckerle et al. 2006:Fig. 65).

We regard the material culture from the cairn as having been deposited on multiple occasions, that is, the artifact accumulation was attritional over a period of time. At this specialized, ritual-centered structure, passers-by sought out and respectfully donated worn-out, broken, and useable, possibly valued personal belongings. These acts and items were sacrifices of the hunt and other utilitarian acts, with an abundance of objects that had adorned and beautified the People, especially in times of distress and scarcity, that attracted spirits' attention and generosity.

The exclusive presence of Late Precontact Period arrowpoints retrieved from the Shanahan Cairn indicates general contemporaneity with occupational events at Thompson Bottom. Our exploratory attempt to obtain an instrumental, independent measure of a depositional event that took place at the cairn involved the dating of a fragmentary bison (*B. bison*) femur, which yielded an age assessment of 1,360 ± 90 years Before Present (I-8938) from bone collagen; Morlan assumed that this Late Precontact Period date had been corrected by the laboratory for isotopic fractionation. The Thompson Bottom Late Precontact age of 1,165 ± 85 B.P. (I-7029) (Table 24) on wood charcoal nearly overlaps the cairn age at 1-sigma standard deviation, indicating that the respective ages represent contemporaneous occupational (TB) and depositional (SC) events, certainly at 2 sigma.

For purposes of argument, having established the contemporaneity and partly shared material culture, we now assert that the intensity of harvesting perhaps relatively fat canids is a consequence of nutritional stress and was at least an adequate solution to that critical deficit. The bead production industry enabled by canid skeletal remains was a key adjunct to ritual and ceremonial activities. Normative

subsistence reliance on bison, which might have provided inadequate sustenance, necessitated supplementary canid consumption. Probably associated with these survival strategies were supplicative rituals that summoned guardian and animal spirits to be kind and generous to the People undergoing uncommonly precarious times, possibly during winter or early spring months.

Elsewhere, to the north in southern Alberta along the Bow River, excavation of the Majorville Cairn in 1971 yielded a 5,000-year-long period of artifact accumulation. Jim Calder, the excavator, concludes that,

*The Majorville site appears to have functioned as a ceremonial site; however, its exact function is questionable. It seems likely that the site represents a practice closely related to the lifestyle of the plainsmen over five millennia suggesting the site represents a place for ceremonialism performed to ensure the fertility and increase of the bison herds. This function is suggested by the artifact inventory (Calder 1975:iii-iv)*

Recovered from the cairn (without regard to provenience) were (among diverse other kinds of flaked stone artifacts) small, side-notched arrowpoints, cord-marked pottery, fragmentary tubular stone pipes, a fully grooved hammerstone, canid bone and mussel shell beads, and *iniskims*.

The Shanahan Cairn may well be derived from Northern Plains ceremonial sites and, within it, the spirit-centered ritual activities conducted at Thompson Bottom. In this sense, then, we have managed to interpret and understand some of the traditions and imperatives that underlay the native adaptation glimpsed lightly, but persuasively, at Thompson Bottom.


**Figure 47.** Fragmentary stone tubular smoking pipes from Shanahan Cairn (Hurd Collection).

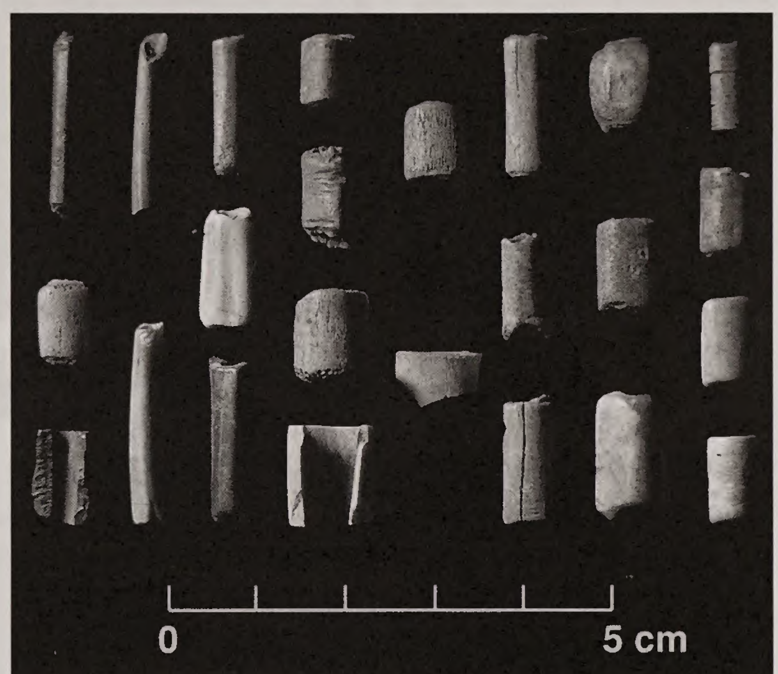



**Figure 48.** Finished and unfinished canid bone and bird beads from Shanahan Cairn (Hurd Collection).

**Figure 49.** 1975 salvage excavations by MSU archaeologists at Shanahan Cairn, looking upriver.

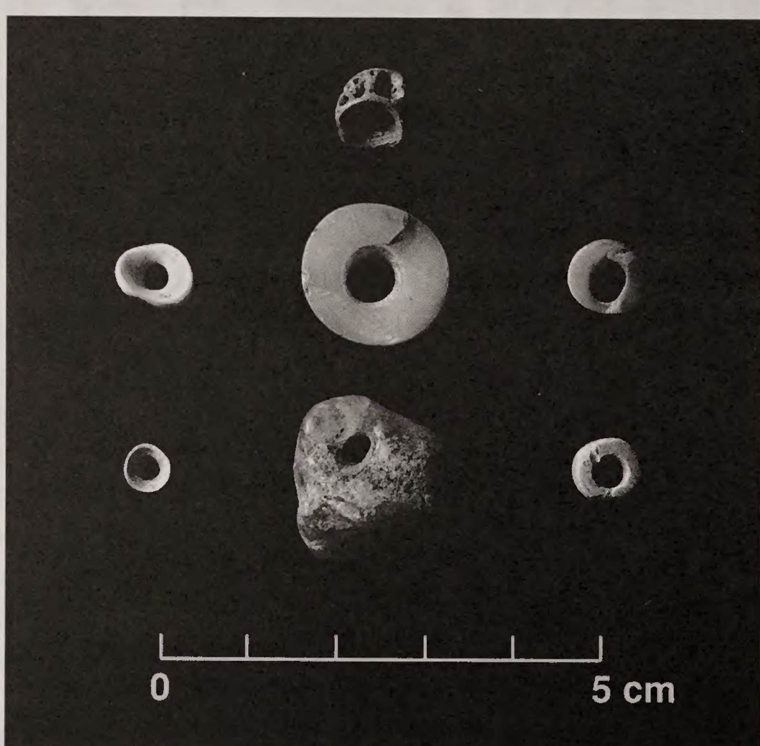



**Figure 50.** Miscellaneous artifacts salvaged from Shanahan Cairn (Brumley Collection).


**Figure 51.** Eyed bone needle, finished bird bone and mussel shell beads, a twice-perforated mussel shell gorget, and small, triangular side-notched arrowpoints from Shanahan Cairn (MSU Collection).

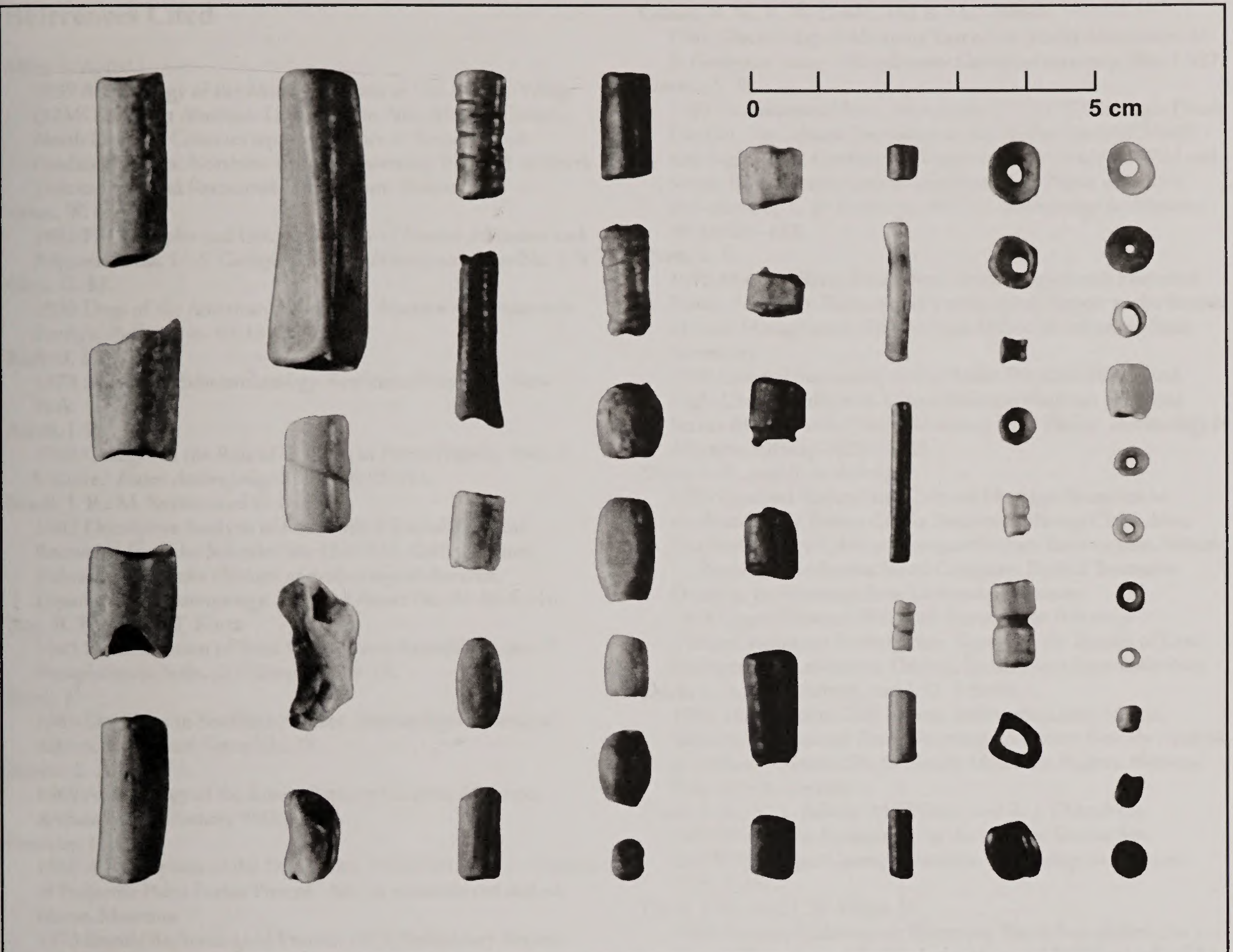
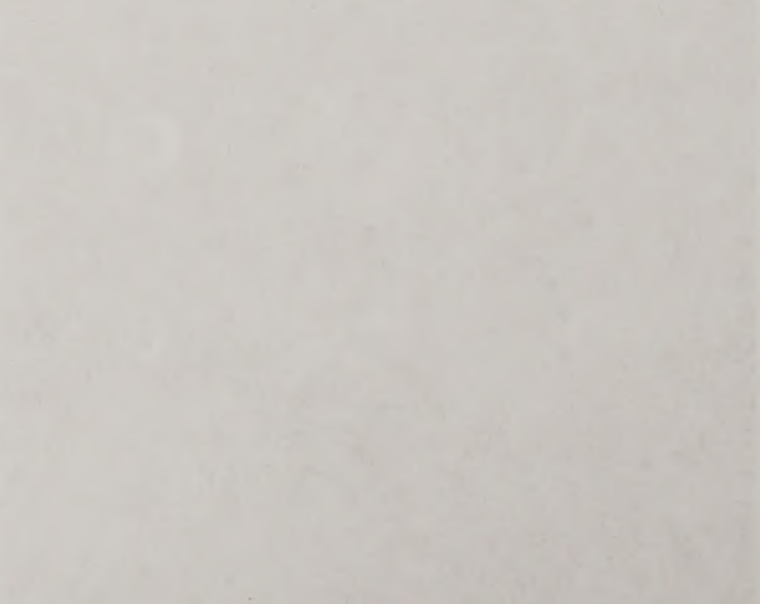
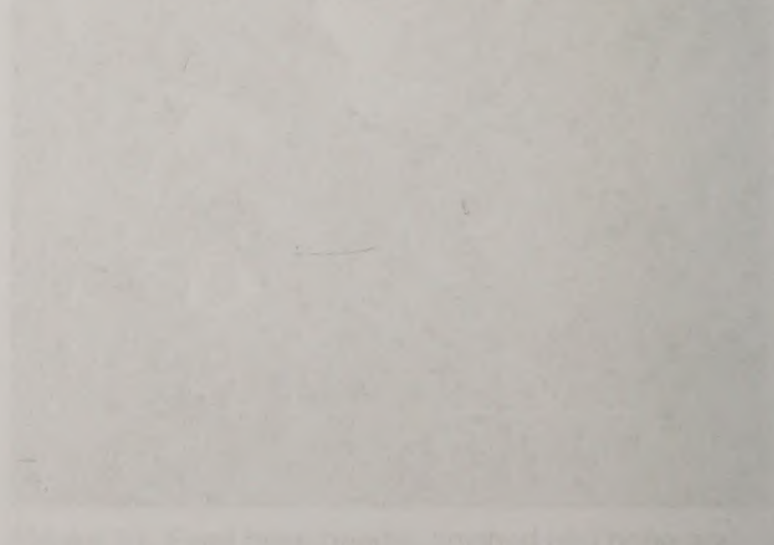



**Figure 52.** Finished and unfinished canid, bird, and fish vertebra beads from Shanahan Cairn (Brumley Collection).





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## Appendix A-1. Morphology of Thompson Bottom Sediments.

| Sample # | Horizon | Soil Morphology* |
|---|---|---|
| 1 | A-C | 0 to 10 cm, light brownish gray (2.5Y 6/2) loam, 17-19% clay; dark grayish brown (2.5Y 4/2); weak medium and fine blocky structure; slightly hard dry, nonsticky, slightly plastic wet; common fine roots; pH 8; effervescent. |
| 2 | C1 | 10 to 13 cm, light brownish gray (2.5Y 6/2) clay loam to silty clay loam, 25-30% clay; dark grayish brown (2.5Y 4/2); moderate fine platy structure; hard to very hard, dry, very sticky, plastic wet; common fine roots; pH 8; effervescent. |
| 3 | C4 | 13 to 23 cm, light brownish gray (2.5Y 6/2) sandy loam, 12-15% clay; dark grayish brown (25.Y 4/2.5) weak medium subangular block structure; hard dry, nonsticky to slightly sticky, lightly plastic wet; common fine roots; pH 8; strong effervescence. |
| 4 | C3 | 23 to 38 cm, light brownish gray (2.5Y 6/2) loamy fine sand, less than 5% clay; dark grayish brown (2.5Y 4.5/2.5); single grain and weak fine subangular blocky structure; loose dry; nonsticky, nonplastic wet; few to common fine roots; pH 8; effervescent. |
| 5 | C4 | 38 to 40 cm, light brownish gray (2.5Y 6/2) silt loam, 10-12% clay; dark grayish brown (2.5Y 4.5/2.5); weak medium and fine subangular blocky structure; very soft dry, sticky, slightly plastic wet; common fine roots; pH 8; effervescent. |
| 6 | Allb | 40 to 42 cm, grayish brown (2.5Y 5/2) loam, 12-15% clay; very dark grayish brown (2.5Y 3/2); weak to moderate medium and fine subangular blocky structure; hard dry, sticky, slightly plastic wet; common fine roots, pH 8; noneffervescent. |
| 7 | C5 | 42 to 50 cm, light brownish gray (2.5Y 6.5/2.5) loam, 10-14% clay; dark grayish brown (4.5/2.5); weak medium subangular blocky breaking to weak fine platy structure; very hard dry, slightly sticky, slightly plastic wet; common to medium fine roots; pH 8; violently effervescent. |
| 8 | C6 | 50 to 56 cm, grayish brown (2.5Y 5.5/2) loam to heavy silt loam, 15-19% clay; dark grayish brown (4.5/2.5); weak to moderate medium and fine subangular blocky structure; hard dry, sticky, slightly plastic wet; common fine roots; pH 8; effervescent. |
| 9 | C7 | 56 to 73 cm, light brownish gray (2.5Y 6.5/2.5) loam to silt loam, 13-16% clay; dark grayish brown (2.5Y 4.5/2); massive; slightly hard dry, slightly sticky, slightly plastic wet; few fine roots; concentric rust-colored mottles; pH 8; strongly effervescent. |
| 10 | C8 | 73 to 93 cm, grayish brown (2.5Y 5.5/2) loam, 15-17% clay; (2.5Y 4.5/2) weak medium and fine angular blocky structure; hard dry, nonsticky to slightly sticky, slightly plastic wet; few to common fine roots; few fine lime threads and seams; few rust-colored mottles along tubular pore walls; pH 8; violently effervescent. |
| 11 | C9 | 93 to 98 cm, light brownish gray (2.5Y 6/2) heavy sandy loam, 8-12% clay; (2.54Y 4.5/2.5); massive; very soft to loose dry, nonsticky to slightly sticky, nonplastic; pH 8; effervescent. |
| 12 | C10 | 98 to 113 cm, light brownish gray (2.5Y 6/2.5) loam to silt loam, 10-14% clay; dark grayish brown (2.5Y 4.5/2.5); massive; hard dry, slightly sticky, slightly plastic wet; few fine roots; few fine rust-colored mottles in tubular pores; few fine lime threads and seams; pH 8; strongly effervescent. |

| Sample # | Horizon | Soil Morphology* |
|---|---|---|
| 13 | C11 | 113 to 133 cm, light gray (2.5Y 7/2) loamy sand, less than 5% clay; dark grayish brown (2.5Y 4.5/2); single grained; loose dry, nonsticky, nonplastic wet; cross-bedded geologic structure; pH 8; strongly effervescent. |
| 14 | C12 | 133 to 150 cm, light yellowish brown (2.5Y 6.5/3) sandy loam, 5-10% clay; light olive brown (2.5Y 5/3); massive; soft dry, nonsticky to slightly sticky, nonplastic to slightly plastic wet; very few fine roots; very few fine pockets of lime; pH 8; strongly effervescent. |
| 15 | A12b | 150 to 153 cm, grayish brown (2.5Y 5.5/2) heavy loam, 19-24% clay; very dark grayish brown (2.5Y 3.5/2); weak medium and fine subangular blocky structure; slightly hard dry, sticky, slightly plastic to plastic wet; very few fine roots; common fine lime pockets and seams; few fine to medium flecks of charcoal, scattered bones, and bone fragments; pH 8; strongly effervescent. |
| | A12b | (inclusion) very pale brown (10YR 8/3) brittle and porous bands, pockets, and lenses of calcareous bone-like material that is violently effervescent, found in the lower part of the horizon; probable anthromorphic origin with probable secondary carbonate accumulation, usually less than 1 cm thick. |
| 16 | C13 | 153 to 178 cm, light brownish gray (2.5Y 6/2) loam, 15-17% clay; dark grayish brown (2.5Y 4/2); massive; slightly hard dry, slightly sticky, slightly plastic wet; very few fine roots; few fine lime pockets and seams; few fine tubular pores; pH 8; strongly effervescent. |
| 17 | C14 | 178 to 204 cm, light brownish gray (2.5Y 6.5/2.5) silt loam, 18-20% clay; (2.5Y 4.5/2) weak fine subangular blocky structure; very hard dry, sticky, nonplastic wet; very few fine roots; few fine lime pockets and threads; pH 8; violently effervescent. |
| 18 | C15 | 204 to 211 cm, light brownish gray (2.5Y 6/2) loam, 14-17% clay, dark grayish brown (2.5Y 4.5/2.5); massive; hard dry, slightly sticky, slightly plastic wet; very few fine roots; very few fine lime pockets; pH 8; strongly effervescent. |
| 19 | C16 | 211 to 228 cm, light brownish gray (2.4Y 6.5/2) loamy sand, less than 5% clay; dark grayish brown (2.5Y 4.5/2); single grained; loose dry, nonsticky, nonplastic wet; pH 8; strongly effervescent. |
| 20 | C17 | 228 to 243 cm, light brownish gray (2.5Y 6/2) heavy sandy loam, 15-18% clay; dark grayish brown (2.5Y 4/2); massive; hard dry, nonsticky, slightly plastic wet; few fine lime pockets; pH 8; strongly effervescent. |
| 21 | C18 | 243 to 253 cm, light gray (2.5Y 7/2) loamy sandy, less than 5% clay; dark grayish brown (2.5Y 4.5/2); single grained; loose dry, nonsticky, plastic wet; pH 8; strongly effervescent. |
| 22 | C19 | 253 to 270 cm, light brownish gray (2.5Y 6/2.5) light loam, 8-12% clay; dark grayish brown (2.5Y 4.5/2.5); massive; slightly hard dry, nonsticky, nonplastic to slightly plastic wet; pH 8; strongly effervescent. |
| 23 | C20 | 270 to 293 cm, light gray (2.5Y 7/2) loamy fine sand, less than 5% clay; dark grayish brown (2.5Y 4.5/2.5); massive and single grained; very soft dry, nonsticky, nonplastic wet; pH 8; strongly effervescent. |
| 24 | C21 | 293 to 300 cm, light gray (2.5Y 7/2) very gravelly loamy sand and sand; dark grayish brown (2.5Y 4.5/2); single grained; loose dry, nonsticky, nonplastic wet; pH 8; strongly effervescent; 40 to 60% rounded gravels and 15 to 20% rounded cobbles. |

**Colors are listed dry followed by moist.*

## Appendix A-2. Chemical and Physical Data for Thompson Bottom Sediments.

| Sample Number | Depth (cm) | Organic Matter % | Available P (ppm) | $CaCO_3$ Eq. (%) | MECHANICAL ANALYSIS Sand (%) | Silt (%) | Clay (%) | Texture |
|---|---|---|---|---|---|---|---|---|
| 1 | 0-10 | 2.0 | 60 | 10.6 | 38 | 40 | 22 | loam |
| 2 | 10-13 | 2.5 | 12 | 7.3 | 18 | 41 | 41 | silty clay loam |
| 3 | 13-23 | 2.8 | 35 | 6.4 | 40 | 31 | 29 | clay loam |
| 4 | 23-38 | 0.5 | 3 | 7.3 | 68 | 13 | 18 | sandy loam |
| 5 | 38-40 | 1.0 | 1 | 9.2 | 46 | 32 | 22 | loam |
| 6 | 40-42 | 4.1 | 91 | 6.1 | 36 | 38 | 26 | clay loam |
| 7 | 42-50 | 1.5 | 29 | 12.5 | 28 | 48 | 24 | clay loam |
| 8 | 50-56 | 4.4 | 58 | 9.1 | 40 | 33 | 27 | clay loam |
| 9 | 56-73 | 0.7 | 1 | 10.8 | 26 | 48 | 26 | clay loam |
| 10 | 73-93 | 1.0 | 52 | 11.5 | 22 | 52 | 26 | clay loam |
| 11 | 93-98 | 0.1 | 3 | 8.7 | 60 | 24 | 16 | sandy loam |
| 12 | 98-113 | .6 | 1 | 9.6 | 26 | 58 | 16 | silt loam |
| 13 | 113-133 | 0.1 | 1 | 5.9 | 84 | 6 | 10 | loamy sand |
| 14 | 133-150 | 0.1 | 1 | 4.7 | 58 | 24 | 18 | sandy loam |
| 15 | 150-153 | 1.5 | 239 | 10.0 | 29 | 45 | 26 | loam |
| 16 | 153-178 | 0.5 | 1 | 10.6 | 39 | 40 | 21 | loam |
| 17 | 178-204 | 0.8 | 1 | 9.5 | 27 | 48 | 25 | loam |
| 18 | 204-211 | 0.4 | 1 | 10.4 | 40 | 37 | 23 | loam |
| 19 | 211-228 | 0.1 | 1 | 7.3 | 77 | 10 | 13 | sandy loam |
| 20 | 228-243 | 0.1 | 1 | 10.5 | 53 | 32 | 15 | sandy loam |
| 21 | 243-253 | 0.1 | 1 | 7.5 | 77 | 11 | 12 | sandy loam |
| 22 | 253-270 | 0.1 | 1 | 10.8 | 41 | 36 | 22 | loam |
| 23 | 270-293 | 0.1 | 1 | 7.2 | 74 | 13 | 22 | sandy loam |
| 24 | 293-300 | 0.1 | 9 | 6.1 | 84 | 0 | 16 | sandy loam |
| 25 | 300- | 0.3 | 1 | 11.4 | 9 | 50 | 41 | silty clay |

## Appendix B. Provenience of Faunal Remains, by Taxon.

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| 7 | A 0S0W<br>20-30 cm<br>B D #2 | cf. *Peromyscus* sp. | Left femur, proximal half. |
| 28 | | *Bison bison* | Left mandible, juvenile, complete. Missing incisors and $dP_2$. $dP_4$ in full wear. $M_1$ erupting, but just above alveolar rim; not worn. |
| 29 | | *Antilocapra americana* | Right mandible, complete. Missing incisors. $P_{2-4}$ damaged.<br>$M_{1-3}$ in full wear. Coronoid process chewed to ragged edge with tooth-punctures. |
| 30 | | *Erethizon dorsatum* | Incomplete right mandible with $P_4$-$M_2$; $M_3$ broken in bud.<br>Ascending process broken away; ragged break with tooth- punctures. |
| 31 | | *Cervus elaphus* | Antler, tine 1, possibly used as tool. |
| 32 | | cf. *Cervus elaphus* | Antler splinter, shaped into long rod for tool of unknown purpose. |

| | | |
|---|---|---|
| 34 | large ungulate | Rib shaft splinter, ragged spiral and clean longitudinal breaks. Polished on exterior and lightly at one end; no striations, and crescentic fracture at polished end. Polish could be work of scavenging canids. Not clearly a tool. |
| 35 | large ungulate | Scapular blade fragment with spine; fashioned into lobate spatula or knife. Highly polished after spine was cut away; one edge shows longitudinal striations possibly from use. Proximal (vertebral) end shows crescentic fractures and tooth-puncture from scavenger after tool was made. |
| 36 | small ungulate, deer/sheep/antelope | Metatarsal shaft splinter with portion of proximal end; fashioned into an awl. Highly polished, and surface is covered with both transverse and longitudinal striations. Snapped at about midlength by levering. |
| 37, 38 | small ungulate, deer/sheep/antelope | Metatarsal shaft splinter with portion of proximal end; fashioned into an awl. Highly polished, and surface shows weak transverse and longitudinal striations. Snapped twice in midshaft area by levering; pieces do not fit together, but are almost certainly from the same tool. |
| 39 | large ungulate | Rib shaft fragment, with ragged transverse and longitudinal breaks. One end is pointed and polished, but the surface is extensively tooth-punctured and the polish is likely the work of a scavenging canid. Not clearly a tool. |
| 40 | cf. canid | Short segment of shaft of metapodial, girdled and snapped for working into a bead. |
| 41 | canid, size of coyote | Distal end and shaft portion of right MCV, girdled and snapped from use of shaft for beads. |
| 42 | canid, larger than coyote | Distal end and shaft portion of left MCV, girdled and snapped from use of shaft for beads. |
| 43 | canid, size of coyote (except j, fox-sized canid) | 11 bone fragments, (phalanges and metapodials) used in bead manufacture.<br>a. Distal end and shaft portion of a medial metapodial (III-IV), girdled and snapped.<br>b. Ditto.<br>c. Ditto.<br>d. Distal end and shaft portion of left? metacarpal II, girdled and snapped.<br>e. Proximal end of proximal phalanx, girdled and snapped.<br>f. Ditto.<br>g. Proximal end and shaft portion of right metacarpal III, girdled and snapped.<br>h. Distal end and shaft portion of right metatarsal V, girdled and snapped.<br>I. Proximal end of proximal phalanx, girdled and snapped.<br>j. (Fox-sized canid) distal end and shaft portion of left metatarsal V, girdled and snapped.<br>k. Proximal end of proximal phalanx, girdled and snapped. |
| 44 | canid, size of coyote | 3 bone fragments (phalanges and metapodial) used in bead manufacture.<br>a. Proximal end of proximal phalanx, girdled and snapped.<br>b. Proximal end and shaft portion of right metacarpal II, girdled and snapped.<br>c. Distal end of proximal phalanx, girdled and snapped. |
| 45 | canid, size of coyote | Proximal third of left metatarsal V, girdled and snapped for bead manufacture. Two girdled areas had not been snapped. |
| 46 | canid, larger than coyote | Proximal third of right metatarsal V, girdled and snapped for bead manufacture. A spirally girdled area had not been snapped. Bone surface extensively striated. |
| 47 | *Castor canadensis* | Fragment of lower incisor, snapped. Striated bevelled surface on inside of curve suggests that it is a use-broken fragment of beaver mandible/incisor gouge. |
| 48 | canid, size of coyote | 3 bones (metapodial and phalanges), one used in bead manufacture.<br>a. Medial phalanx, complete.<br>b. Proximal phalanx, complete.<br>c. Distal end and shaft portion of right metacarpal II, girdled and snapped. These three elements were probably articulated. |
| 50 | canid, size of coyote | 20 bones (metapodials and phalanges) used in bead manufacture.<br>a. Distal end and shaft portion of left metacarpal III, girdled and snapped. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| | | | b. Distal end and shaft portion of left metacarpal II, girdled and snapped.<br>c. Distal end and shaft portion of left metacarpal V, girdled and snapped.<br>d. Distal end and shaft portion of left metacarpal IV, girdled and snapped.<br>e. Proximal end of proximal phalanx, girdled and snapped.<br>f. Distal end of proximal phalanx, girdled and snapped.<br>g. Proximal end and shaft portion of left metacarpal III, girdled and snapped. Arthritic erosion.<br>h. Proximal end and shaft portion of right metatarsal V, girdled and snapped.<br>i. Distal end of proximal phalanx, girdled and snapped.<br>j. Proximal end of proximal phalanx, girdled and snapped.<br>k. Ditto.<br>l. Distal end and shaft portion of left metacarpal V, girdled and snapped.<br>m. Distal end and shaft portion of right metatarsal IV, girdled and snapped.<br>n. Distal end of proximal phalanx, girdled and snapped.<br>o. Distal end of proximal phalanx, girdled and snapped.<br>p. Ditto.<br>q. Ditto.<br>r. Proximal end of proximal phalanx, girdled and snapped.<br>s. Ditto.<br>t. Distal end of proximal phalanx, girdled and snapped. |
| 51 | | ? canid | Shaft segment, probably from phalanx, for use as bead. |
| 52 | | ? canid | Shaft segment, probably from metapodial, for use as bead. |
| 53 | | unidentifiable | Shaft splinter (?metapodial) with girdling and snaps at each end and 4 unsnapped girdling grooves. Longitudinally splintered. |
| 54 | | unidentifiable | Tiny dental enamel fragment. Misidentified as bead fragment. |
| 55 | | canid, size of coyote | Proximal end of left metatarsal IV with portion of shaft, girdled and snapped for bead manufacture. Surface striated and polished. |
| 56 | | canid, size of wolf | Proximal end of right metatarsal IV with portion of shaft, girdled and snapped for bead manufacture. Surface striated and polished. |
| 57 | | canid, size of wolf | Proximal end of right metatarsal III with portion of shaft, girdled and snapped for bead manufacture. Surface lightly striated and polished. |
| 58 | | canid, size of coyote | 2 bones (metapodials) used in bead manufacture.<br>a. Midshaft to proximal shaft of unidentified metapodial; proximal end broken away. Girdled and snapped; shaft striated and polished.<br>b. Distal end and shaft portion of right metacarpal V, girdled and snapped. |
| 59 | | ? canid | Polished bead, likely made from canid metapodial segment. Globular. |
| 60 | | ? canid | Midshaft portion, probably of canid metapodial. Girdled and snapped at each end; two girdling grooves in middle. Polished; could be finished bead. |
| 61 | | canid, size of coyote (except c, fox-sized) | 3 bones (metapodials) used in bead manufacture.<br>a. Proximal end and shaft portion of left metatarsal III, girdled and snapped.<br>b. Proximal end and shaft portion of left metacarpal II, girdled and snapped.<br>c. Proximal end and shaft portion of left metatarsal II, girdled and snapped. |
| 62 | | *Canis* sp., size of coyote | Right ulna, proximal half. Midshaft area striated and polished; girdled and snapped for bead manufacture. |
| 63 | | *Canis* sp., size of wolf | Proximal end and shaft portion of left metacarpal V, girdled and snapped for bead manufacture. Surface polished and striated. |
| 64 | | *Canis* sp., size of wolf | Proximal end and shaft portion of left metacarpal III, girdled and snapped for bead manufacture. |

| | | | |
|---|---|---|---|
| 65 | | *Canis* sp., size of coyote | Shaft fragment of left ulna, girdled and snapped for bead manufacture. Spiral break proximally. |
| 66 | | *Canis* sp., size of coyote | Proximal end and shaft portion of left metacarpal V, girdled and snapped for bead manufacture. Surface polished. |
| 67 | | *Canis* sp., size of coyote (except c, wolf-sized) | 4 bones (phalanx and metapodials) used in bead manufacture.<br>a. Proximal end and shaft portion of right metatarsal III, girdled and snapped.<br>b. Proximal end and shaft portion of right metacarpal III, girdled and snapped.<br>c. Distal end and shaft portion of right metacarpal ?II.<br>d. Distal end of proximal phalanx, girdled and snapped. |
| 68 | | ? Canid | Bead preform snapped from ?canid ?metapodial shaft. Not polished. |
| 69 | | unidentifiable | Bead preform snapped from hollow bone and faceted by grinding. Not polished. |
| 70 | | *Canis* sp., size of coyote | 5 bones (metapodials) used in bead manufacture.<br>a. Proximal end and shaft portion of right metacarpal III, girdled) and snapped. Shaft striated and polished.<br>b. Proximal end and shaft portion of left metacarpal III, girdled and snapped. Shaft striated and polished.<br>c. Distal end and shaft portion of medial (III-IV) metapodial, girdled and snapped.<br>d. Proximal end and shaft portion of right metatarsal IV, girdled and snapped.<br>e. Distal end and shaft portion of medial (III-IV) metapodial, girdled and snapped. Shaft striated. |
| 71 | | *Canis* sp., size of coyote | Right ulna, midshaft portion, striated and polished. Girdled and snapped distally. Proximal end snapped away by scavenger; tooth-scoring present. Used in bead manufacture |
| 72 | | *Canis* sp., size of wolf | Proximal half of right metatarsal III, girdled and snapped for bead manufacture. One girdling groove remains unsnapped. Shaft striated and polished. |
| 73 | | *Canis* sp., size of wolf | Patella, possibly gnawed by scavenger; misidentified as artifact. |
| 74 | | *Dentalium* sp. | Shell fragment, likely used for bead. |
| C-1 | | *Canis* sp. | Skull, missing right premaxilla, both canines, and several other teeth. Dorsal portion of left maxilla snapped away. Right zygomatic arch snapped away. Left zygomatic/maxillary suture (malar) pathological. Orbital processes tooth-scored. Fits right premaxilla C-636. |
| C-2 | A 0S0W | *Canis* sp. | Right mandible, complete; missing incisors and $P_1$. Gonion chewed; horizontal ramus tooth-scored. Ventral border pathological. Fits C-1. |
| C-3 | A 0S0W | *Canis* sp. | Left mandible, counterpart of C-2. Complete; missing incisors and $P_1$. Fits C-1. |
| C-5 | | *Canis* sp. | Left mandible, nearly complete, missing incisors. Ascending ramus snapped away above condyle |
| C-6 | | *Canis latrans* | Left mandible, complete, missing incisors, $P_1$ and $M_3$. Fits C. |
| C-7 | | *Canis latrans* | Right mandible, complete, counterpart of C-6. Missing incisors, $P_1$ and $M_3$. Fits C-9. |
| C-8 | | cf. *Canis latrans* | Posterior fragment of right parietal and supraoccipital, bounded by uneven snap breaks. |
| C-9 | | *Canis latrans* | Skull, anterior half, with cranial portions snapped away. Missing all incisors but $RI^3$; and missing LC, $LP^1$ and $LM^2$ |
| C-10 | | cf. *Canis latrans* | Right glenoid fossa of temporal; does not fit C-9. |
| C-11 | | cf. *Canis* latrans | Occipital condyles, bounded by uneven snap fractures. Possibly fits C-9. |
| C-12 | | cf. *Canis latrans* | Right temporal, glenoid fossa and zygomatic process; fits C-9. Uneven snap fractures. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| C-13 | | *Canis* sp. | Skull, nearly complete. Dorsal portion of left maxilla snapped away and dorsal portion of right maxilla fragmentd. Incisors missing, as is $RP^1$. $RP^3$ was lost antemortem. |
| C-15 | | *Canis* sp. | Right mandible, complete, missing $RI_{1-2}$ and $RM_3$. $RM_1$ broken postmortem. Fits C-13. |
| C-16 | | cf. *Bison bison* | Endocranial wall fragment, bounded by uneven snap fractures. |
| C-17 | | *Canis latrans* | Left mandible, nearly complete. Missing incisors. Ascending ramus punctured and partially snapped away. Pathological - swelling on lingual face below $P_4$-$M_1$. |
| C-18 | | *Canis* sp. | Isolated canine tooth, likely $RC^1$. |
| C-19 | | *Canis latrans* | Right mandible, nearly complete. Counterpart to C-17. Missing incisors, $P_1$, $P_3$, $M_2$, $M_3$. Ascending ramus snapped away above condyle. |
| C-20 | | *Canis* sp. | Skull in several pieces, in need of restoration. Young adult with unworn teeth; most of dentition present. Cranial fragments tooth-scored. |
| C-21 | | *Canis* sp. | Right temporal, glenoid fossa and auditory bulla. May go with C-20. |
| C-22 | | *Canis* sp. | Left mandible, anterior fragment with $LC_1$. Incisors missing. Uneven spiral fractures. |
| C-23 | | *Canis* sp. | Posterior portion of cranium. Uneven to ragged fractures; tooth- scoring on zygoma. |
| C-24 | | *Canis* sp. | Left mandible, complete. Missing $L_{1-2}$, $P_1$, $P_3$, and $P_4$. |
| C-25 | | *Canis* sp. (very large) | Right mandible, nearly complete. Missing incisors, canine. Ascending ramus snapped above condyle. |
| C-26 | | *Canis* sp. | Left maxilla (and anterior portion of zygomatic arch, C-28) Maxilla is a fragment with $P^4$-$M^2$ Ragged to uneven spiral fractures. |
| C-27 | | *Canis* sp. | Right maxillary fragment, counterpart to C-25. Has broken $P^4$; $M^{1-2}$ present. Bounded by ragged to uneven spiral fractures. |
| C-28 | | *Canis* sp. | Left zygomatic arch, anterior portion. Fits C-26. |
| C-29 | | *Canis* sp. | Right mandible, nearly complete. Only $P_3$ intact and $P_4$ roots present; other teeth absent. |
| C-30 | A 0S0W | *Canis* sp. | $LI^1$. |
| C-31 | A 0S0W | *Canis* sp. | $RI_2$. |
| C-32 | A 0S0W | *Canis* sp. | Canine, broken. |
| C-33 | A 0S0W | *Canis* sp. | $RI^2$. |
| C-34 | A 0S0W | *Canis* sp. | Incisor, broken. |
| C-35 | A 0S0W | *Canis* sp. | $LI_2$. |
| C-36 | A 0S0W | *Canis* sp. | $LI_1$. |
| C-37 | A 0S0W | *Canis* sp. | $LI^3$. |
| C-38 | A 0S0W | *Canis* sp. | $LP_1$. |
| C-39 | A 0S0W | *Canis* sp. | $LP_1$. |
| C-40 | A 0S0W | *Canis* sp. | $RP^3$. |
| C-41 | A 0S0W | *Canis* sp. | $RP_4$. |

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| C-42 | A 0S0W | *Canis* sp. | $RI_1$. |
| C-43 | A 0S0W | *Canis* sp. | $RP_1$. |
| C-44 | A 0S0W | *Canis* sp. | Incisor, broken. |
| C-45 | A 0S0W | *Canis* sp. | $LI_1$. |
| C-46 | A 0S0W | *Canis* sp. | $LI_3$. |
| C-47 | A 0S0W | *Canis* sp. | $LP^3$. |
| C-48 | A 0S0W | *Canis* sp. | Canine, broken. |
| C-49 | A 0S1W | *Canis* sp. | $LP^1$. |
| C-50 | A 0S1W | *Canis* sp. | Incisor, broken. |
| C-51 | A 0S1W | *Canis* sp. | Premolar, broken. |
| C-52 | A 0S1W | *Canis* sp. | Incisor, heavily worn. |
| C-53 | A 0S1W | *Canis* sp. | Incisor, heavily worn. |
| C-54 | A 0S1W | *Canis* sp. | Premolar root. |
| C-55 | A 0S1W | *Canis* sp. | Incisor, heavily worn. |
| C-56 | A 0S2W | *Canis* sp. | Incisor, heavily worn. |
| C-57 | A 0S2W | *Canis* sp. | $LP_1$. |
| C-58 | A 0S2W | *Bison bison* | $LdP_2$. |
| C-59 | A 1S2W | *Canis* sp. | Canine, broken. |
| C-60 | Hearth #1 | *Canis* sp. | Canine root. |
| C-61 | Hearth #1 | *Canis* sp. | Premolar, broken. |
| C-62 | Hearth #1 | *Canis* sp. | $RM^2$, broken. |
| C-63 | Hearth #1 | *Canis* sp. | Tooth fragment. |
| C-64 | | *Canis* sp. | Cranial fragment (parietal), right, bounded by snap fractures. |
| C-69 | A 0S1W<br>5-25 cm | *Canis* sp. | Complete axis vertebra, mature. |
| C-70 | A lSlW<br>15-30 cm | cf. *Canis* sp. | Left posterior rib, distal shaft fragment. Snapped proximally. |
| C-71 | A lSlW<br>15-30 cm | cf. *Canis* sp. | Left posterior rib, proximal shaft fragment, snapped proximally and distally. Fits C-70 and midshaft break could be post- depositional. Head snapped away; ragged diagonal break. |
| C-72 | A 0S1W<br>baulk | *Canis* sp. | Complete cervical vertebra #5, mature. |
| C-73 | A 0S1W<br>baulk | *Canis* sp. | Complete cervical vertebra #6, mature. |
| C-74 | A 0S1W<br>baulk | *Canis* sp. | Cervical vertebra #7, mature, complete except for distal end of left transverse process, snapped away. |
| C-75 | A 0S2W<br>10-20 cm | *Canis* sp. | Cervical vertebra #6, mature, complete except for right transverse process, snapped away. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| C-76 | A 0S2W 10-20 cm | *Canis* sp. | Distal half of right posterior rib, freshly snapped in recovery. Fits C-150 (A lSlW, 15-30 cm); one of these proveniences is incorrect. |
| C-77 | A 0S2W 10-20 cm | *Canis* sp. | Atlas vertebra, complete except for small area on right ala snapped by scavenger |
| C-78 | A 0S2W 10-20 cm | *Canis* sp. | Proximal half of left mid-series rib, freshly snapped during recovery. |
| C-79 | A lSlW 15-30 cm | *Canis* sp. | Right ulna, proximal one-third, raggedly snapped below semilunar notch. |
| C-80 | A 0S2W 10-20 cm | *Canis* sp. | Cervical vertebra #6, mature, complete except for ventral flange of transverse process, snapped away. |
| C-81 | A 0S2W 10-20 cm | *Canis* sp. | Right mid-series rib, proximal two-thirds. Ragged snap distally. |
| C-82 | A 0S2W 10-20 cm | *Bison bison* | Fetal left scapula. Ragged edges proximally and distally, and tooth-punctures on external face. |
| C-83 | A 0S2W 10-20 cm | *Canis* sp. | Right mid-series rib, most of shaft. Ragged snaps proximally (just below head) and distally. |
| C-84 | A 0S2W 10-20 cm | cf. *Bison bison* | Mid-series rib, shaft fragment, ragged to spiral fractures proximally and distally. Broken edges on one end show polish and some striations; this end is pointed. The other end shows a transverse snap-break. Digging tool? |
| C-85 | A 0S2W 10-20 cm | *Canis* sp. | Left mid-series rib, most of shaft. Ragged snaps proximally (just under head) and distally. |
| C-86 | A 0S2W 10-20 cm | *Canis* sp. | Left anterior rib, most of shaft. Ragged snaps proximally (at head) and distally. Tooth-punctures associated with proximal break. |
| C-87 | A lS2W 20-30 cm | *Bison bison* | Right humerus, juvenile. Proximal and distal articular areas missing and adjacent shaft snapped. Tooth-punctures visible along with scoring at both ends. |
| C-88 | Hearth #1 | *Canis* sp. | Right tibia, missing proximal end. Mature. Proximal break shows scoring and tooth-punctures. |
| C-89 | Hearth #1 | *Canis* sp. | Right radius, mature. Two transverse cut marks on anterior face near proximal end look like trowel marks. Minor scooping (scavenger damage) at proximal end. |
| C-90 | A 0S1W 0-25 cm B D #2 | *Canis* sp. | Right scapula, incomplete. Fits onto C-107 (fresh break); is still missing neck and glenoid area. Ragged break at neck. |
| C-91 | A 0S1W 15-25 cm B D #2 | *Canis* sp. | Left femur, mature, incomplete. Greater trochanter snapped away and distal end missing. Ragged break proximally and possible tooth-puncture. Ragged break distally with tooth-scoring. |
| C-92 | A 0S1W 5-25 cm B D #2 | *Canis* sp. | Right anterior rib, head and proximal part of shaft. Ragged snap distally. |
| C-93 | A 0S1W 5-25 cm B D #2 | *Canis* sp. | Left anterior rib, head and proximal half of shaft. Ragged snap distally. |
| C-94 | A 0S2W 10-20 cm | *Canis* sp. | Thoracic neural spine. Ragged snaps proximally and distally. |

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| C-95 | A 0S1W<br>5-25 cm<br>B D #2 | *Canis* sp. | Cervical vertebra #4, mature. Both transverse processes truncated anteriad by snaps. |
| C-96 | A 0S2W<br>10-20 cm | *Canis* sp. | Left posterior rib, proximal half. Ragged snap at midshaft. |
| C-97 | A 0S2W<br>10-20 cm | *Canis* sp. | Left posterior rib, midshaft section. Ragged snap proximally below head.<br>Fresh break distally. |
| C-98 | On river below<br>XU:A | *Canis* sp. | Left tibia and fibula, distal two-thirds. Ragged break proximally with<br>tooth-punctures distally. |
| C-99 | On river below<br>XU:A | *Canis* sp. | Left innominate, incomplete. Ilium broken away at sacral<br>scar; ischium broken at tuber ischii. Ragged breaks with tooth-punctures. |
| C-100 | A 0S2W<br>10-20 cm | *Canis* sp. | Right radius, probably mature. Distal end broken away, ragged break with<br>light tooth-punctures. |
| C-101 | A 0S2W<br>10-20 cm | *Canis* sp. | Atlas vertebra, complete. Mature. |
| C-102 | A 0S1W<br>5-25 cm<br>B D #2 | *Canis* sp. | Cervical vertebra #3, mature. Complete except for small portion of right<br>postzygapophysis, snapped away. |
| C-103 | A 0S1W<br>15-25 cm<br>B D #2 | cf. *Bison bison* | Left mid-series rib, subadult, proximal half of shaft.<br>Ragged snap proximally between head and tubercle.<br>Ragged snap distally at midshaft. |
| C-104 | A 0S2W<br>10-20 cm | *Canis* sp. | Right mid-series rib, proximal one-third. Snapped proximally<br>between head and tubercle. Freshly snapped distally. |
| C-105 | A lS2W<br>20-30 cm | cf. *Bison bison* | Left mid-series rib, subadult, proximal half of shaft. Ragged snap proximally below head<br>with light tooth-punctures. Ragged snap distally at midshaft. |
| C-106 | A 0S1W<br>5-25 cm<br>B D #2 | *Canis* sp. | Thoracic vertebra #1, mature. Complete except for distal end of neural spine.<br>Spine snapped near distal end with ragged break. |
| C-107 | A 0S1W<br>5-25 cm<br>B D #2 | *Canis* sp. | Scapula fragment (see C-90). |
| C-108 | A 0S2W<br>10-20 cm | *Canis* sp. | Left mid-series rib, proximal two-thirds. Ragged distal snap-break. |
| C-109 | A 0S2W<br>10-20 cm | *Canis* sp. | Right mid-series rib, shaft fragment. Truncated proximallyand distally by ragged<br>snap-breaks. Tooth-puncture associated with distal break. Proximal break just below head. |
| C-110 | A lSlW<br>15-30 cm | *Canis* sp. | Left posterior rib, nearly complete. Snapped proximally between head and tubercle;<br>ragged distal snap just short of distal end. |
| C-111 | A 0S2W<br>10-20 cm | *Canis* sp. | Left mid-series rib, proximal four-fifths. Ragged distal break. |
| C-112 | A 0S2W<br>10-20 cm | *Canis* sp. | Left posterior rib, shaft fragment. Snapped proximallyand distally with ragged breaks.<br>Tooth-punctures near proximal end. |
| C-113 | A 0S2W<br>10-20 cm | *Canis* sp. | Left mid-series rib, proximal three-quarters. Ragged distal break with tooth-punctures. |
| C-114 | A 0S2W<br>10-20 cm | cf. *Pedioecetes phasianellus* | Right humerus, complete. Tooth-punctures in area of proximal end. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| C-115 | A 0S1W<br>15-25 cm<br>B D #2 | *Canis* sp. | Left scapula, with vertebral border and much of spine snapped away.<br>Ragged fractured edges. |
| C-116 | A 0S2W<br>10-20 cm | cf. *Antilocapra americana* | Distal condyle of metatarsal and portion of shaft, highly abraded and polished.<br>Snapped proximally by ragged spiral break. Heavily chewed above condyle by scavenger.<br>Looks to have been an awl or similar tool, snapped from use and discarded. |
| C-117 | A 0S0W<br>20-30 cm | *Canis* sp. | Right innominate, incomplete. Ischium snapped away just behind acetabulum.<br>Ilium snapped at anterior border of sacral scar. Pubic symphysis partly fused - female? |
| C-118 | A 0S0W<br>20-30 cm | *Canis* sp. | Fragment of ischium from C-117; probably a post-depositional break. |
| C-119 | A 2S2W<br>10-20 cm<br>B D #2 | *Lepus townsendii* | Right femur, distal shaft fragment. Distal end tooth-punctured.<br>Ragged spiral fractures. |
| C-120 | A 1S1W<br>15-30 cm<br>B D #2 | small canid | Fragment of cervical neural arch, snapped.<br>Ragged to spiral fractures. |
| C-121 | A lSlW<br>15-30 cm<br>B D #2 | small canid | Posterior thoracic or anterior lumbar neural arch fragment, snapped.<br>Ragged breaks with tooth-punctures. |
| C-122 | A lSlW<br>15-30 cm<br>B D #2 | small canid | Fragment of neural arch, fits C-121, fresh break. |
| C-123 | A 0S2W<br>10-20 cm | cf. *Canis* sp. | Left anterior rib shaft fragment.<br>Ragged breaks proximally (below head) and distally. |
| C-124 | A 0S2W<br>10-20 cm | cf. *Canis* sp. | ?right mid-series rib shaft fragment.<br>Ragged breaks proximally and distally. |
| C-125 | A 0S2W<br>10-20 cm | small canid | Thoracic neural arch (incomplete) with spine.<br>Ragged snapped margin. |
| C-126 | A 0S2W<br>10-20 cm | mammal | Indeterminate bone fragment, longitudinally fractured<br>and with a ragged transverse fracture. |
| C-127 | A 0S2W<br>10-20 cm | small canid | Fragment of neural arch and spine, thoracic vertebra.<br>Ragged snapped margins. |
| C-128 | A 0S2W<br>10-20 cm | mammal | Indeterminate bone fragment, with ragged spiral fractures. |
| C-129 | A 0S2W<br>10-20 cm | *Bison bison* | Fetal tibia, distal half, heavily tooth-punctured.<br>Spiral fracture at midshaft and ragged fracture distally. |
| C-130 | A 0S1W<br>5 cm<br>B D #2 | ?*Canis* sp. | Posterior rib shaft fragment.<br>Ragged breaks proximally and distally. |
| C-131 | A 0S1W<br>5 cm<br>B D #2 | ?*Canis* sp. | Posterior rib shaft fragment.<br>Ragged breaks proximally and distally. |
| C-132 | A 0S1W<br>5 cm<br>B D #2 | *Antilocapra americana* | Complete 2nd phalanx, heavily chewed. |

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| C-133 | A 0S1W<br>5 cm<br>B D #2 | *Bison bison* | Fetal left rib #1, tiny.<br>Ragged break and tooth-puncture distally. |
| C-134 | A 0S1W<br>5 cm<br>B D #2 | *Bison bison* | Fetal metapodial (unfused), probably metacarpal<br>Complete. Tiny. |
| C-135 | Hearth #1 | *Bison bison* | Fetal left scapula, heavily tooth-punctured.<br>Spine and vertebral border snapped away, with ragged breaks. |
| C-136 | A W Extension | *Canis* sp. | Right mid-series rib shaft, snapped just below head. Ragged snap. |
| C-137 | A W Extension | *Canis* sp. | Right anterior rib, proximal half. Ragged distal shaft break, with tooth-puncture. |
| C-138 | A W Extension | ungulate | Lower incisor, complete. Lateral (?$RI_3$), lightly worn. |
| C-139 | A W Extension | ?canid | Caudal vertebra, complete. |
| C-140 | A 0S2W<br>10-25 cm | ungulate | Lower incisor, complete, ?$LI_2$, heavily worn. |
| C-141 | A 0S2W<br>10-25 cm | ?canid | Caudal vertebra, complete. |
| C-142 | A 0S1W<br>17-20 cm<br>B D #2 | cf. *Canis* sp. | Proximal caudal vertebra, complete. |
| C-143 | A 0S1W<br>17-20 cm<br>B D #2 | cf. *Canis* sp. | Caudal vertebra, complete. Goes with C-142. |
| C-144 | A 0S1W<br>17-20 cm<br>B D #2 | cf. *Canis* sp. | Caudal vertebra, complete. Goes with C-142-143. |
| C-145 | A 0S1W<br>17-20 cm<br>B D #2 | cf. *Canis* sp. | Caudal vertebra, complete. Goes with C-142-144. |
| C-146 | A 0S1W<br>17-20 cm<br>B D #2 | cf. *Canis* sp. | Caudal vertebra, complete. Goes with C-142-145. |
| C-147 | A 0S1W<br>17-20 cm<br>B D #2 | cf. *Canis* sp. | Caudal vertebra, complete. Goes with C-142-146. |
| C-148 | A 1S1W<br>15-30 cm<br>B D #2 | small canid | Posterior lumbar vertebra, arch and right transverse process.<br>Ragged breaks. |
| C-149 | A 1S1W<br>15-30 cm<br>B D #2 | ?small canid | Distal half of rib, freshly broken at midshaft. |
| C-150 | A 1S1W<br>15-30 cm<br>B D #2 | ?small canid | Complete right anterior-series rib (includes C-76).<br>Head lightly damaged. |
| C-151 | A 1S1W<br>15-30 cm<br>B D #2 | *Bison bison* | Subadult right posterior series rib, proximal shaft fragment with tubercle.<br>Ragged fractures proximally and distally. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| C-152 | A 1S1W<br>15-30 cm<br>B D #2 | cf. *Bison bison* | Fetal right humerus, tiny, nearly complete (diaphysis).<br>Anomalous - large foramen on posterior aspect at midshaft.<br>This and bone texture are unlike other fetal bison humeri I have seen. Not bison? |
| C-153 | A 1S1W<br>15-30 cm<br>B D #2 | mammal | Calcified costal cartilage. |
| C-154 | A 1S1W<br>15-30 cm<br>B D #2 | ?ungulate, small | Sternebra, incomplete.<br>Heavily tooth-punctured; ragged break |
| C-155 | A 1S1W<br>15-30 cm<br>B D #2 | mammal | Calcified costal cartilage. |
| C-156 | A 1S1W<br>15-30 cm<br>B D #2 | cf. *Bison bison* | Fetal left humerus, complete diaphysis, tiny. |
| C-157 | A 1S1W<br>15-30 cm<br>B D #2 | *Bison bison* | Fetal right radius, nearly complete diaphysis.<br>Tooth-punctures. |
| C-158 | A 1S1W<br>15-30 cm<br>B D #2 | mammal | Small fragment of bone, unidentifiable.<br>Looks to be from articular end of large bone. |
| C-159 | A 1S1W<br>15-30 cm<br>B D #2 | mammal | ?maxillary fragment, small. Ragged broken edges. |
| C-160 | A 2S2W<br>20-30 cm<br>B D #2 | *Bison bison* | Fetal right scapula; vertebral border and spine snapped away. |
| C-161 | A 2S2W<br>20-30 cm<br>B D #2 | mammal | Calcified costal cartilage. |
| C-162 | A 2S2W<br>20-30 cm<br>B D #2 | ungulate | Deciduous lower incisor, unworn, ?$RDI_2$. |
| C-163 | Hearth #1 | *Canis* sp. | Right anterior-series rib head and proximal shaft. Ragged distal snap break. |
| C-164 | Hearth #1 | small canid | Left anterior-series rib, middle portion of shaft. Proximal spiral fracture below head.<br>Distal ragged fracture. |
| C-165 | Hearth #1 | small canid | Left mid-series rib, distal two-thirds of shaft.<br>Ragged proximal and distal breaks, tooth-punctures at distal end |
| C-166 | Hearth #1 | *Canis* sp. | Left posterior-series rib, complete. |
| C-167 | Hearth #1 | *Canis* sp. | Right posterior-series rib, midshaft fragment. Ragged fractures proximally and distally. |
| C-168 | Hearth #1 | small canid | Left mid-series rib, midshaft fragment. Ragged fractures proximally and distally. |
| C-169 | Hearth #1 | cf. small canid | Right mid-series rib, small midshaft fragment. Ragged fractures proximally and distally. |
| C-170 | Hearth #1 | small canid | Left mid-series rib, midshaft fragment. Ragged fractures proximally and distally. |

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| C-171 | Hearth #1 | *Canis* sp. | Right posterior-series rib, proximal three quarters, immature. Ragged snap distally. Includes C-173 (freshly broken). |
| C-172 | Hearth #1 | small canid | Left mid-series rib, midshaft three quarters. Ragged fractures proximally and distally. |
| C-173 | Hearth #1 | *Canis* sp. | See C-171. |
| C-174 | Hearth #1 | *Canis* sp. | Right mid-series rib, proximal end. Freshly broken below head. |
| C-175 | Hearth #1 | *Canis* sp. | Carpal, complete. |
| C-176 | Hearth #1 | *Canis* sp. | Carpal, complete. |
| C-177 | A lS2W<br>20-30 cm<br>B D #2 | *Bison bison* | Fetal right ilium, nearly complete.<br>Snapped around margin of blade. |
| C-178 | A lS2W<br>20-30 cm<br>B D #2 | ungulate | Calcified costal cartilage. |
| C-179 | A lS2W<br>20-30 cm<br>B D #2 | ?*Bison bison* | Fetal flat bone fragment. Ragged fractures. |
| C-180 | A 1S2W<br>20-30 cm<br>B D #2 | mammal | Small fragment of much larger bone (flat bone?);<br>irregular broken margins. |
| C-181 | A lS2W<br>20-30 cm<br>B D #2 | *Bison bison* | Fetal right femur, diaphysis, tooth-punctured. |
| C-182 | A 1S2W<br>20-30 cm<br>B D #2 | ungulate | Calcified costal cartilage. |
| C-183 | A 1S2W<br>20-30 cm<br>B D #2 | ungulate | Calcified costal cartilage, tooth-punctured. |
| C-184 | A lS2W<br>20-30 cm<br>B D #2 | ungulate | Calcified costal cartilage; ragged fractures. |
| C-185 | A lS2W<br>20-30 cm<br>B D #2 | ungulate | Calcified costal cartilage; ragged fractures. |
| C-186 | A 0S0W<br>20-30 cm<br>B D #2 | *Canis* sp. | Right posterior-series rib, nearly complete.<br>Snapped between head and tubercle and just short of distal end; ragged breaks.<br>Tooth-punctures proximally. |
| C-187 | A 0S0W<br>20-30 cm<br>B D #2 | ?*Canis* sp. | Shaft fragment of femur, spirally fractured.<br>Tooth-scored and punctured. |
| C-188 | A 0S0W<br>20-30 cm<br>B D #2 | small canid | Mid-series rib shaft fragment, freshly broken proximally<br>and ragged break distally. |
| C-189 | A 0S0W<br>20-30 cm<br>B D #2 | ?small canid | Lumbar pleurapophysis, snapped from arch.<br>Ragged snapped breaks. |

| Number | Provenience | Taxon | Description |
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| C-190 | A 0S0W<br>20-30 cm<br>B D #2 | | Fetal right ulna, nearly complete.<br>Minor amount snapped away distally. |
| C-191 | A 0S0W<br>20-30 cm<br>B D #2 | ?small canid | Lumbar pleurapophysis, snapped from arch.<br>Ragged snapped breaks. |
| C-192 | A 0S0W<br>20-30 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, heavily chewed and tooth-punctured. |
| C-193 | A 0S0W<br>20-30 cm<br>B D #2 | ungulate | Lower incisor, complete (?$LI_2$). Lightly worn. |
| C-194 | A 0S0W<br>20-30 cm<br>B D #2 | ungulate | Lower incisor, complete (?$RI_3$). Lightly worn.<br>Deciduous? |
| C-195 | A 0S0W<br>20-30 cm<br>B D #2 | ungulate | Lower incisor, complete (?$LI_3$), Lightly worn, Deciduous?<br>Counterpart of C-194. |
| C-196 | A 0S0W<br>20-30 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, complete. |
| C-197 | A 0S0W<br>20-30 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, heavily chewed. |
| C-198 | A 0S1W<br>15-25 cm | *Canis* sp. | Left mid-series rib, head, freshly broken downshaft from tubercle. |
| C-199 | A 0S1W<br>15-25 cm | small canid | Left posterior-series rib, complete except for tiny portion of distal end,<br>Ragged distal fracture. |
| C-200 | A 0S1W<br>15-25 cm | small canid | Left posterior-series rib, complete except for head.<br>Spiral fracture downshaft from tubercle. |
| C-201 | A 0S1W<br>15-25 cm | *Canis* sp. | 2nd phalanx, complete. |
| C-202 | A 0S1W<br>15-25 cm | *Canis* sp. | 2nd phalanx, complete, lightly chewed. |
| C-203 | A 0S1W<br>15-25 cm | ?small canid | Proximal phalanx, complete. |
| C-204 | A 0S1W<br>15-25 cm | *Bison bison* | Fetal metatarsal, unfused. Complete diaphysis. |
| C-205 | A 0S1W<br>15-25 cm | *Bison bison* | Fetal metacarpal, unfused. Complete diaphysis. |
| C-206 | A 0S1W<br>15-25 cm | *Bison bison* | Fetal metacarpal, unfused. Complete diaphysis. |
| C-207 | A 0S1W<br>15-25 cm | *Bison bison* | Fetal right tibia, complete diaphysis. Tooth-scored. |

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| C-208 | A 0S1W<br>15-25 cm | *Bison bison* | Fetal left tibia, complete diaphysis. |
| C-209 | A 0S1W | *Canis* sp. | 2nd phalanx, complete. |
| C-210 | A 0S1W | *Bison bison* | Fetal right anterior-series rib, snapped distally and between head and tubercle. Ragged snaps. |
| C-211 | A 0S1W | ungulate | Calcified costal cartilage. |
| C-212 | A 2S2W<br>20-30 cm | *Bison bison* | Left posterior-series rib, nearly complete. Snapped proximally between head and tubercle; ragged break. Distal end chewed; tooth-punctured and ragged. |
| C-213 | A 2S2W<br>20-30 cm | *Bison bison* | Right mid-series rib, nearly complete. Snapped proximally downshaft from tubercle; spiral break. Distal end and nearby margin chewed and snapped; tooth-punctured and ragged. |
| C-213 | | | Two possible light transverse cut marks on external surface just down from area of tubercle; other marks fresh. |
| C-214 | A 2S2W<br>20-30 cm | *Bison bison* | Left mid-series rib, distal one-quarter, freshly broken proximally.<br>Distal end chewed, tooth-punctured. |
| C-215 | A 2S2W<br>20-30 cm | *Bison bison* | Right mid-series rib, nearly complete. Snapped proximally downshaft from tubercle as in C-213; spiral break. Distal end chewed and snapped; tooth-punctured and ragged. |
| C-216 | A 2S2W<br>20-30 cm | *Bison bison* | Left mid-series rib, proximal portion of shaft. Spiral fracture proximally. Fresh break distally; fits C-217. Numerous short transverse cut marks on external shaft surface below area of tubercle. |
| C-217 | A 2S2W<br>20-30 cm | *Bison bison* | Left mid-series rib, medial portion of shaft.<br>Fresh break distally; fits C-216. Fresh break distally. |
| C-218 | A 2S2W<br>20-30 cm | *Bison bison* | Right mid-series rib, medial portion of shaft.<br>Fresh break proximally. Ragged break distally with tooth-punctures. |
| C-219 | A 2S2W<br>20-30 cm | *Bison bison* | Right mid-series rib, distal half of shaft. Fresh break proximally.<br>Ragged break distally with tooth-punctures and scoring. |
| C-220 | A 2S2W<br>20-30 cm | *Bison bison* | Left mid-series rib, distal three-quarters of shaft. Spiral snap-fracture proximally.<br>Light cut marks or scrape mark on external shaft surface just below area of tubercle.<br>Ragged break barely short of distal end. |
| C-221 | A 2S2W<br>20-30 cm | *Bison bison* | Calcified costal cartilage.<br>Heavily chewed at one end, with tooth-punctures. |
| C-222 | A 2S2W<br>20-30 cm | *Bison bison* | Distal one-quarter of right mid-series rib, freshly broken proximally. Fits C-230. Ragged break distally. |
| C-223 | A 2S2W<br>20-30 cm | *Bison bison* | Lumbar pleurapophysis, ragged breaks proximally and distally.<br>Tooth-punctures and scoring throughout. |
| C-224 | A lSZW<br>20-30 cm | *Bison bison* | Lumbar pleurapophysis, freshly snapped proximally.<br>Ragged distal break, associated with numerous transverse (in terms of pleurapophysis) cut marks on one surface, near what must have been the distal end. |
| C-225 | A lS2W<br>20-30 cm | *Bison bison* | Midshaft rib fragment, freshly broken proximally and distally.<br>Tooth-scoring at one end. |
| C-226 | A lS2W<br>20-30 cm | *Bison bison* | Proximal phalanx, complete.<br>Tooth-scored and punctured over entire length. |
| C-227 | A lS2W<br>20-30 cm | *?Bison bison* | Articular end of large limb bone, small fragment.<br>Cancellous tissue locally burned black. |
| C-228 | A lS2W<br>20-30 cm | *Bison bison* | Right mid-series rib, distal one-third. Freshly broken proximally.<br>Ragged break distally, with light tooth-scoring. |

| Number | Provenience | Taxon | Description |
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| C-229 | A lS2W 20-30 cm | *Bison bison* | Right anterior to mid-series rib, distal half. Freshly broken proximally. Localized cut marks on external surface a short distance up from distal end and on medial surface at distal end. |
| C-230 | A lS2W 20-30 cm | *Bison bison* | Medial two-thirds of right mid-series rib. Ragged snap proximally just below tubercle; tooth-scored and punctured. Freshly broken distally; fits C-222. |
| C-231 | A lS2W 20-30 cm | *Bison bison* | Left mid-series rib, distal half. Freshly broken proximally. Ragged break distally, |
| C-232 | A lS2W 20-30 cm | *Bison bison* | Right mid-series rib, proximal shaft fragment. Ragged to spiral breaks proximally and distally; tooth-punctures proximally, |
| C-233 | A lS2W 20-30 cm | *Bison bison* | Thoracic neural spine distal fragment. Ragged breaks proximally and distally with tooth-punctures. |
| C-234 | A lS2W 20-30 cm | *Bison bison* | Right premaxilla and small portion of maxilla.Medial bar of premaxilla snapped away. Maxilla shows old break medially; fresh break externally (fits C-235). |
| C-235 | A lS2W 20-30 cm | *Bison bison* | Right maxilla, anterior fragment. Fits C-234. Snapped along posterior and ventral margins (ahead of tooth row). Tooth-punctures and ragged break along dorsal margin. Subadult? |
| C-236 | A lS2W 20-30 cm | *Bison bison* | Left mid-series rib, distal one-quarter, juvenile. Spiral snap-fracture proximally. |
| C-237 | A lS2W 20-30 cm | *Bison bison* | Right mid-series rib, proximal shaft fragment. Ragged proximal break with tooth-scoring. Freshly broken distally. |
| C-238 | A lS2W 20-30 cm | *Bison bison* | Mid-series rib, distal shaft fragment, juvenile. Ragged snap proximally; freshly broken distally (fits C-241). |
| C-239 | A lS2W 20-30 cm | *Bison bison* | Left posterior-series rib, middle two-thirds of shaft. Spiral fracture proximally, and fresh break distally. |
| C-240 | A lS2W 20-30 cm | *Bison bison* | Left mid-series rib, juvenile, midshaft fragment. Freshly broken proximally and distally. |
| C-241 | A lS2W 20-30 cm | *Bison bison* | Mid-series rib, juvenile, distal shaft fragment. Freshly broken proximally (fits C-238). Ragged break distally. |
| C-242 | A lS2W 20-30 cm | *Bison bison* | Left mid-series rib, shaft fragment. Freshly broken proximally and distally. |
| C-243 | B Deep trench 87 cm B D #2 | *Bison bison* | a. Juvenile mandible, fragment of wall (2 pieces, reassembled). Fits C-244. b. 6 long bone, rib, mandible, and vertebra fragments, spirally to raggedly fractured. All are small. The mandible fragment fits C-244. |
| C-244 | B Deep trench 87 cm B D #2 | *Bison bison* | Right mandible, juvenile, fragment of ventral half of posterior portion of horizontal ramus, with wall of $M_2$ bud. $M_2$ had no roots. and was likely not erupted. $M_1$ had roots about half formed. Fragment snapped around periphery; some spiral breaks. |
| C-245 | B Deep trench 87 cm B D #2 | *Bison bison* | Right mandible (mature), ascending ramus. Ragged breaks behind $M_3$, some tooth-punctures. |
| C-246 | B Deep trench 87 cm B D #2 | *Bison bison* | Lumbar neural spine, snapped from arch. Ragged break at base, with tooth-punctures. Tooth-punctures also at distal end. |
| C-247 | B Deep trench 87 cm B D #2 | *Bison bison* | Palate fragment, bounded by snap breaks and ragged fractures. |

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| C-248 | B Deep trench<br>87 cm<br>B D 42 | *Bison bison* | Fragment of ventral border of mandible (horizontal ramus).<br>Bounded by uneven spiral to longitudinal fractures and some ragged areas. |
| C-249 | B Deep trench<br>87 cm<br>B D #2 | *Bison bison* | Distal portion of diaphysis of metapodial, probably right metacarpal.<br>Fresh damage, but clearly broken diagonally just above epiphyseal plate.<br>Fracture uneven. Condyles (C-250) unfused. |
| C-250 | B Deep trench<br>87 cm<br>B D #2 | *Bison bison* | Distal condyles of metapodial; fit C-249.<br>Freshly damaged during recovery. |
| C-251 | B Deep trench<br>87 cm<br>B D #2 | *Canis* sp. | Basioccipital fragment with part of right occipital condyle.<br>Irregular spiral fractures. |
| C-252 | B Deep trench<br>87 cm<br>B D #2 | *Bison bison* | Proximal phalanx, complete, but freshly damaged.<br>Discolored, possibly scorched lightly. |
| C-253 | B Deep trench<br>87 cm<br>B D #2 | *Bison bison* | Proximal phalanx, proximal portion of ventral surface, freshly broken.<br>Discolored; possibly scorched. |
| C-254 | B Deep trench<br>87 cm<br>B D #2 | *Bison bison* | Distal sesamoid, complete. |
| C-255 | B Deep trench<br>87 cm<br>B D #2 | *Bison bison* | Distal sesamoid, complete. |
| C-256 | A 0S2W<br>10-20 cm | *Bison bison* | Rib shaft fragment, spirally fractured. Freshly broken longitudinally. Tooth-scoring. |
| C-257 | A 0S2W<br>10-20 cm | *Bison bison* | Radius, left, posterior face, shaft fragment. Spirally fractured. |
| C-258 | A 0S2W<br>10-20 cm | *Bison bison* | Long bone (?radius) shaft fragment. Spirally fractured. |
| C-259 | A 0S2W<br>10-20 cm | *Bison bison* | Posterior thoracic neural spine fragment, snapped from arch.<br>Split longitudinally and raggedly broken, with tooth-punctures and scoring. |
| C-260 | A 0S2W<br>10-20 cm | *Bison bison* | Long bone shaft fragment. Spirally fractured. |
| C-261 | A 0S2W<br>10-20 cm | *Bison bison* | Left mid-series rib, distal one-fifth. Ragged snap-break proximally.<br>Distal end shows ragged damage with tooth-punctures and scoring. |
| C-262 | A 0S2W<br>10-20 cm | *Bison bison* | Radius, anterior shaft fragment, bounded by spiral fractures. |
| C-263 | A 0S2W<br>10-20 cm | *Bison bison* | Right mid-series rib, proximal shaft fragment.<br>Ragged snap-break proximally just below area of tubercle. Freshly broken distally. |
| C-264 | A 0S2W<br>10-20 cm | *Bison bison* | Left mid-series rib, distal shaft fragment, juvenile.<br>Ragged breaks proximally and distally, with tooth-scoring and punctures. |
| C-265 | A 0S2W<br>10-20 cm | *Bison bison* | Left radius and ulna, distal half. Spirally fractured at midshaft with point of impact unclear - possibly anteroexternal and at midshaft. Epiphyseal line still visible. |
| C-266 | Hearth #1 | *Bison bison* | Left mid-series rib, proximal shaft fragment, juvenile. Snapped cleanly proximally, with light polish from scavenger action. Freshly broken distally. |
| C-267 | Hearth 41 | *Canis* sp. | Right anterior to mid-series rib, proximal one-third. Ragged break distally. |

| Number | Provenience | Taxon | Description |
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| C-268 | Hearth #1 | *Canis* sp. | Left posterior rib, complete except for head. Sharply snapped proximally. |
| C-269 | Hearth #1 | ?small canid | Mid-series rib, midshaft two-thirds. Ragged breaks proximally and distally, with tooth-punctures and scoring. |
| C-270 | Hearth #1 | mammal (small?) | Possible vertebral fragment, with irregular breaks and tooth-punctures. |
| C-271 | Hearth #1 | small mammal | Rib, midshaft fragment with irregular proximal and distal breaks |
| C-272 | Hearth #1 | *Canis* sp. | 3rd phalanx, complete. |
| C-273 | Hearth #1 | *Canis* sp. | 3rd phalanx, complete. |
| C-274 | Hearth #1 | ?*Bison bison* | Fetal left mid-series rib, proximal three-quarters. Fits C-276. Fresh break. |
| C-275 | Hearth #1 | ?*Bison bison* | Fetal left mid-series rib, proximal three-quarters. Fits C-277. Fresh break. |
| C-276 | Hearth #1 | ?*Bison bison* | Fetal left mid-series rib, distal one-quarter. Fits C-274. |
| C-277 | Hearth #1 | ?*Bison bison* | Fetal left mid-series rib, distal one-quarter. Fits C-275. |
| C-278 | Hearth #1 | *Canis* sp. | 2nd phalanx, complete. |
| C-279 | Hearth #1 | cf. pelecypod | Small shell fragment. Rich mother-of-pearl color play. |
| C-280 | A 0S1W | *Canis* sp. | Left posterior-series rib, proximal half. Ragged distal snap-break. |
| C-281 | A 0S1W | *Canis* sp. | Right anterior-series rib, proximal half. Freshly broken at midshaft. |
| C-282 | A 0S1W | *Canis* sp. | Left anterior-series rib, proximal half. Ragged distal break (fresh?). |
| C-283 | A 0S1W | *Canis* sp. | Thoracic vertebra, right transverse process and left postzygapophysis snapped away. Distal end of neural spine snapped away, ragged break. |
| C-284 | A 0S1W | small mammal | Rib, distal half. Ragged break at midshaft. (?small canid) |
| C-285 | A 0S1W | small mammal | Right mid-series rib, proximal one-third (?small canid). Snapped proximally between head and tubercle; spiral break. Ragged snap distally, above midshaft. |
| C-286 | A 0S1W | cf. *Canis* sp. | Transverse process of cervical vertebra, snapped from centrum. Spiral fractures. |
| C-287 | A 0S1W | cf. *Bison bison* | Fetal left ilium, snapped just ahead of acetabulum. Very tiny. |
| C-288 | A 0S1W | ef. *Bison bison* | ?juvenile left mandible, diastemal fragment. Longitudinally split and raggedly fractured at both ends. |
| C-289 | A 0S1W | *Canis* sp. | Right astragalus, nearly complete. Minor damage of head. |
| C-290 | A 0S1W | *Canis* sp. | 2nd phalanx, complete. |
| C-291 | A 0S1W | cf. *Canis* sp. | Fibula, shaft fragment. Freshly broken at both ends. |
| C-292 | A 0S1W | *Canis* sp. | Proximal phalanx, complete. Heavily chewed, eroded (partially digested). |
| C-293 | A 0S1W | *Canis* sp. | Caudal vertebra, complete. |
| C-294 | A 0S1W | *Canis* sp. | Caudal vertebra, complete. |
| C-295 | A 0S1W | *Canis* sp. | a. 2nd phalanx, complete.<br>b. 2nd phalanx, complete; heavily chewed; eroded (partially digested).<br>c. 3rd phalanx, complete. |

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| | | cf. *Bison bison* | Three tiny fetal ribs, freshly damaged distally. |
| | | unidentifiable | Two bone fragments, one possibly a vertebral zygapophysis. |
| C-296 | Hearth #1 | *Canis* sp. | Left mid-series rib, complete. |
| C-297 | Hearth #1 | ?*Canis* sp | Long bone (?tibia) shaft fragment. Freshly broken. Tooth-scored. |
| C-298 | Hearth #1 | cf. *Canis* sp. | Mid-series rib, distal shaft fragment. Ragged breaks proximally and distally. |
| C-299 | Hearth #1 | *Bison bison* | Fetal left frontal, nearly complete. Snapped along margins. |
| C-300 | Hearth #1 | *Canis* sp. | Left metacarpal I, complete. |
| C-301 | Hearth #1 | *Canis* sp. | Proximal phalanx, complete. Chewed proximally and distally. |
| C-302 | Hearth #1 | *Canis* sp. | 2nd phalanx, complete. Heavily chewed throughout; eroded (partly digested). |
| C-303 | Hearth #1 | small mammal | Mid-series rib, distal fragment, freshly snapped proximally. |
| C-304 | Hearth #1 | cf. *Bison bison* | Fetal thoracic neural spine, crushed proximally where snapped from arch. |
| C-305 | Hearth #1 | *Bison bison* | Fetal left mid-series rib, proximal half. |
| C-306 | Hearth #1 | mammal | Calcified costal cartilage |
| C-307 | Hearth #1 | cf. *Bison bison* | Fetal basisphenoid, locally snapped around margin; one wing partially represented and the other missing |
| C-308 | Hearth #1 | *Bison bison* | Fetal phalanx, complete diaphysis. |
| C-309 | Hearth #1 | cf. *Bison bison* | Fetal rib, proximal shaft fragment. Snapped proximally and distally. |
| C-310 | Hearth #1 | small mammal | a. ?calcaneum, badly eroded (partly digested by scavenger).<br>b. Tiny ?caudal vertebra. |
| | | *Bison bison* | a. Fetal right ulna, nearly complete.<br>b. Fetal left ulna, nearly complete (tiny).<br>c. Five fragments of fetal ribs, tiny. |
| | | unidentifiable | Three cranial fragments, very small. |
| C-311 | A 0S0W | *Canis* sp. | Proximal phalanx, complete. Heavily chewed; eroded (partially digested). |
| C-312 | A 0S0W | *Canis* sp. | Caudal vertebra, freshly broken distally. |
| C-313 | A 0S0W | ?*Canis* sp. | Juvenile rib, proximal shaft fragment. Snapped proximally and distally. |
| C-314 | A 0S0W | ?*Canis* sp. | Fetal or juvenile rib, proximal shaft fragment. Snapped distally. |
| | | unidentified mammal | Small bone fragment: styloid process? |
| C-315 | A 0S0W | *Bison bison* | Fetal left anterior-series rib, nearly complete. Snapped between head and tubercle. Ragged break distally. |
| C-316 | A 0S0W | cf. pelecypod | Small shell fragment with mother-of-pearl color play. Lumpy (?abalone). |
| | | unidentified mammal | Tiny cranial fragment. |
| C-317 | A 0S1W | *Canis* sp. | 2nd phalanx, complete. |
| C-318 | A 0S1W | cf. *Bison bison* | Fetal tibia, distal third. Snapped at midshaft. |
| | | ?small canid | a. 2nd phalanx, complete.<br>b. 3rd phalanx, complete. |

| Number | Provenience | Taxon | Description |
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| | | cf. small canid | a. Sesamoid, complete.<br>b. Caudal vertebra, complete. |
| | | cf. *Discus* sp. | Complete shell. |
| C-319 | A 0S1W<br>10 cm<br>B D #2 | *Bison bison* | Fetal right calcaneum, complete. |
| C-320 | A 0S1W<br>10 cm<br>B D #2 | *Bison bison* | a. Fetal rib, shaft, snapped.<br>b. Vestigial tarsal, complete.<br>c. Fragment of tooth bud. |
| | | *Canis* sp. | Carnassial fragments (2). |
| | | ?small canid | ?baculum. |
| | | cf. *Discus* sp. | One shell, incomplete. |
| C-321 | A lS0W<br>15-30 cm<br>B D #2 | *Canis* sp. | Partial right scapula, blade. Anterior fragment with most of length, including portion of rim of glenoid fossa. Ragged, broken edges with tooth-punctures. |
| C-322 | A lS0W<br>15-30 cm | small canid | Midshaft three-quarters of mid-series rib.<br>Ragged snaps proximally and distally; distal break looks fresh. |
| C-323 | A lS0W<br>15-30 cm<br>B D #2 | small canid | Midshaft three-quarters of mid-series rib.<br>Ragged snaps proximally and distally; proximal break looks fresh. |
| C-324 | A lS0W<br>15-30 cm<br>B D #2 | *Canis* sp. | Proximal phalanx, complete. |
| C-325 | A lS0W<br>15-30 cm<br>B D #2 | *Bison bison* | Fetal left mid-series rib, nearly complete. Snapped near distal end. |
| C-326 | Hearth #1 | *Canis* sp. | Right metatarsal II, complete. Chewed on proximal end, with tooth-punctures. |
| C-327 | Hearth #1 | *Bison bison* | Unerupted $RdP_4$, posterior two-thirds, freshly broken. Fits C-328.Weakly mineralized - fetal. |
| C-328 | Hearth #1 | *Bison bison* | Unerupted $RdP_4$, anterior one-third, freshly broken. Fits C-327.Weakly mineralized - fetal. |
| C-329 | Hearth #1 | *Bison bison* | Unerupted $RdP_3$, complete. Weakly mineralized - fetal. |
| C-330 | Hearth #1 | *Canis* sp | 3rd phalanx, complete |
| C-331 | Hearth #1 | *Canis* sp. | 3rd phalanx, complete. |
| C-332 | Hearth #1 | *Canis* sp. | Two fragmentary molars. |
| | | *Bison bison* | Three fragments of unerupted molar, fetal. |
| | | unidentifiable mammal | Small cranial fragment. |
| | | succineid gastropod | Complete shell. |
| C-333 | A 0S2W<br>10-24 cm<br>B D #2 | *Bison bison* | Fetal right mid-series rib. |

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| C-334 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | Left mid-series rib, proximal half. Ragged break distally. |
| C-335 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | Right (?) mid-series rib, midshaft one-half. Freshly broken proximally.<br>Ragged snap distally with tooth-punctures. |
| C-336 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | Right mid-series rib, proximal one-third.<br>Ragged snap distally, with fresh damage. |
| C-337 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | Right anterior-series rib, proximal one-third.<br>Freshly broken distally. |
| C-338 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | Thoracic neural spine, snapped from arch.<br>Spirally fractured from arch. |
| C-339 | A 0S2W<br>0-20 cm<br>B D #2 | cf. *Canis* sp. | Rib shaft fragment. Ragged broken edges. |
| C-340 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, complete. |
| C-341 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | 2nd phalanx, complete, |
| C-342 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | 2nd phalanx, complete. |
| C-343 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal left tibia, with ragged breaks proximally and distally.<br>Numerous tooth-punctures. |
| C-344 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal right scapula, incomplete.<br>Vertebral border snapped away leaving ragged break above mid length. |
| C-345 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal metatarsal, unfused. |
| C-346 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal femur, midshaft fragment, side uncertain.<br>Ragged breaks proximally and distally, with tooth-punctures. |
| C-347 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal atlas vertebra, left half. |
| C-348 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | a. Fetal right mid-series rib, snapped distally.<br>b. Fetal thoracic vertebral centrum.<br>c. Fetal molar fragments (2) |
| | | cf *Canis* sp. | Caudal vertebra, epiphysis. |
| | | ?small canid | Shaft of fibula, very slender. |
| | | unidentified mammal | Two cranial or cancellous tissue fragments. |
| | | pelecypod | Small shell fragment. |

| Number | Provenience | Taxon | Description |
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| C-349 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal metatarsal, unfused, complete diaphysis. |
| | | unidentified mammal | unidentifiable bone fragments (27). |
| | | ?pelecypod | Tiny shell fragment. |
| | | unidentified | 12 pieces of charcoal; some could be burned bone. |
| C-350 | Hearth #3 | cf. *Spermophilus* sp. | 6 vertebrae (thoracic, lumbar), 2 metapodials, 1 proximal phalanx, and 1 lower incisor. |
| | | cf . *Microtus* sp. | Distal three-quarters of right humerus; partial right innominate; metapodial. |
| | | cf. *Cynomys* sp. | Cervical vertebrae #1, 2, and 3; 3 lumbar vertebrae; partial left scapula; sternebra; and baculum. 7 rib fragments, referred. |
| | | unidentifiable | 7 bone fragments |
| C-351 | A 0S1W<br>15-25 cm<br>B D #2 | *Canis* sp. | Right mid-series rib, proximal one-third.<br>Ragged distal snap-break. |
| C-352 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Fetal left mid-series rib, complete. |
| C-353 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Fetal left frontal, incomplete. Snapped around margin. |
| C-354 | A 0S1W<br>15-25 cm<br>B D #2 | cf. *Canis* sp. | Midshaft fragment of rib; ragged proximal and distal breaks. |
| C-355 | A 0S1W<br>15-25 cm<br>B D #2 | ?small canid | Midshaft fragment of posterior-series rib;<br>ragged proximal and distal breaks. |
| C-356 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Fetal molar fragment (unerupted tooth bud). |
| C-357 | A 0S1W<br>15-25 cm<br>B D #2 | *Canis* sp. | a. Sesamoid bone, complete.<br>b. Sesamoid bone, complete.<br>c. Carpal bone, complete.<br>d. Carpal bone, complete.<br>e. Distal end of metapodial, heavily eroded (partially digested).<br>f. 3 incisors.<br>g. Caudal vertebra, snapped at mid-length.<br>h. Cervical transverse process fragment. Fits C-95. |
| | | *Bison bison* | a. Fetal ribs, 3 shaft fragments, mid-series, one with head.<br>b. Fetal left premaxilla, complete.<br>c. Fetal metacarpal, unfused, complete.<br>d. Fetal cervical neural arch, one half.<br>e. Fetal basisphenoid with wings; tiny.<br>f. Five fragments of fetal (unerupted) molars. |
| | | unidentifiable | 11 small bone fragments. |
| C-358 | A 0S2W<br>10-20 cm | *Bison bison* | Left trapezoid carpal, complete. |

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| C-359 | A 0S2W<br>10-20 cm | cf. *Bison bison* | Right mid-series rib, subadult, midshaft fragment.<br>Freshly broken proximally and distally. |
| C-360 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, snapped from arch.<br>Light transverse cut marks on lateral surface (left) near base. Ragged breaks proximally and distally; tooth-scoring and punctures. Light polish on chewed area at base. |
| C-361 | A 0S2W<br>10-20 cm | *Bison bison* | Right ulna, olecranon process. Diagonally broken by uneven spiral fracture.<br>Tooth-punctures on one margin. |
| C-362 | A 0S2W<br>10-20 cm | *Bison bison* | Left mid-series rib, shaft fragment.<br>Ragged breaks proximally and distally, with tooth-punctures. |
| C-363 | A 0S2W<br>10-20 cm | *Bison bison* | Left metacarpal, fragment from external portion of proximal end and adjacent shaft.<br>Uneven spiral fractures. |
| C-364 | A 0S2W<br>baulk, main<br>bone level | *Bison bison* | Femur, shaft fragment, bounded by uneven spiral fractures.<br>Fits C-365. |
| C-365 | A 0S2W<br>baulk, main<br>bone level | *Bison bison* | Femur, shaft fragment, bounded by uneven spiral fractures.<br>Fits C-364. |
| C-366 | A 1S0W<br>15-30 cm | *Bison bison* | Left mid-series rib, distal shaft fragment.<br>Ragged breaks proximally and distally; tooth-scoring proximally. |
| C-367 | A 1S0W<br>15-30 cm | *Bison bison* | Thoracic neural spine, snapped from arch.<br>Ragged breaks proximally and distally with tooth-punctures. |
| C-368 | A 1S0W<br>15-30 cm | *Bison bison* | Left scapula, subadult, blade. Snapped in ragged fashion across neck.<br>Ragged snapped edge along vertebral border.<br>Spine snapped away along most of its length. Local tooth-punctures. |
| C-369 | A 0S2W<br>10-20 cm | *Bison bison* | Left lateral malleolus, complete. |
| C-370 | A 0S2W<br>10-20 cm | *Bison bison* | Left tibia, shaft fragment, posterolateral margin just below head.<br>Uneven spiral fractures. |
| C-371 | A 0S2W<br>10-20 cm | *Bison bison* | Left radius, proximal articular end and short section of shaft,<br>truncated by transverse uneven spiral fractures. |
| C-372 | A 0S2W<br>10-20 cm | *Bison bison* | 2nd phalanx, complete. |
| C-373 | A 0S2W<br>10-20 cm | *Bison bison* | Juvenile right femur, midshaft fragment bounded by spiral to uneven spiral fractures. |
| C-374 | A 0S2W<br>10-20 cm | *Bison bison* | Left mid-series rib, distal shaft fragment. Fresh break proximally.<br>Ragged distal break. |
| C-375 | A 0S2W<br>10-21 cm<br>B sub D | *Bison bison* | Lumbar neural spine, snapped from arch.<br>Ragged broken base. |
| C-376 | A 0S2W<br>10-21 cm<br>B sub D | *Bison bison* | Rib shaft fragment, extensively tooth-puncturedand bounded by ragged margins.<br>Polished on ends by licking - scavenger pseudo-tool. |
| C-377 | A 0S2W<br>10-21 cm<br>B sub D | bird, ?heron | Left mandible, anterior fragment. Ragged posterior break with tooth-punctures.<br>Freshly snapped at symphysis. Fits C-378. |
| C-378 | A 0S2W<br>10-21 cm<br>B sub D | bird, ?heron | Right mandible, anterior fragment.<br>Ragged posterior break. Freshly snapped at symphysis. Fits C-377. |

| Number | Provenience | Taxon | Description |
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| C-379 | A 0S2W<br>10-21 cm<br>B sub D | cf. *Bison bison* | Small fragment of cancellous bone -- vertebral?<br>Bounded by sharp snap-breaks. |
| C-380 | A 0S2W<br>10-20 cm | *Bison bison* | Left anterior rib, juvenile, distal half of shaft.<br>Ragged proximal shaft break. Distal end chewed into ragged edge. |
| C-381 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, snapped from arch.<br>Proximal break ragged; distal end ragged with tooth-punctures.<br>A small series of slightly oblique to transverse cut marks noted on left face near base. |
| C-382 | A 0S2W<br>10-20 cm | *Bison bison* | Left scaphoid carpal, complete. |
| C-383 | A 0S2W<br>10-20 cm | *Bison bison* | Right radius, shaft fragment from posterior face at proximal end of ulnar scar.<br>Bounded by uneven spiral fractures. Fits C-384. |
| C-384 | A 0S2W<br>10-20 cm | *Bison bison* | Right radius, shaft fragment from posterior face atproximal end of ulnar scar.<br>Bounded by uneven spiral fractures. Fits C-383. |
| C-385 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, snapped from arch.<br>Proximal break ragged. Distal end chewed ragged and freshly damaged. |
| C-386 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, snapped from arch.<br>Proximal break ragged. Distal end chewed ragged with several tooth-punctures. |
| C-387 | A 0S2W<br>10-20 cm | *Bison bison* | Left mid-series rib, proximal shaft fragment. Ragged proximal and distal snap breaks.<br>Outer curved surface covered with numerous cut marks over a distance of 4.5 cm; cut marks are slightly oblique, slanting down to rear. |
| C-388 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, juvenile, snapped from arch.<br>Proximal break ragged with depressed fracture and tooth-scoring. Distal end ragged.<br>Occasional light transverse cut marks on both lateral faces near base. |
| C-389 | A 0S2W<br>10-20 cm | *Bison bison* | Left patella, chewed on eminences and tooth-punctured. |
| C-390 | A 0S2W<br>10-20 cm | *Bison bison* | Right tibia, posteromedial fragment from lower portion of shaft, showing point of impact near distal end on medial face. Spirally fractured, One edge has overlapping retouch from scavenger-chewing. |
| C-391 | A 0S2W<br>10-20 cm | *Bison bison* | Femur, side uncertain, large shaft fragment. Bounded by uneven spiral fractures.<br>One margin spalled from chewing by scavenger. |
| C-392 | A 0S2W<br>10-20 cm | *Bison bison* | Right mid-series rib, midshaft fragment.<br>Ragged breaks proximally and distally. |
| C-393 | A 0S2W<br>10-20 cm | cf. *Bison bison* | Long bone shaft fragment with part of muscle attachment area.<br>Femur? Uneven spiral fractures. |
| C-394 | A 0S2W<br>10-20 cm | *Bison bison* | ?right mid-series rib, distal one-quarter of shaft.<br>Freshly broken proximally. Ragged distal end with tooth-punctures. |
| C-395 | A 0S2W<br>10-20 cm | *Bison bison* | Juvenile thoracic neural spine, snapped from arch. Ragged proximal snap-break with tooth-punctures and scoring. Distal end shows ragged edge from chewing. |
| C-396 | A 0S2W<br>10-20 cm | *Bison bison* | Humerus, side uncertain, proximal shaft fragment. Uneven spiral to ragged fractured edges, with local tooth-scoring and light polish of eminences. |
| C-397 | A 1S1W<br>15-30 cm<br>B sub D | cf. *Bison bison* | Long bone (likely radius) shaft fragment, bounded by spiral to uneven spiral fractures. |

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| C-398 | A 1S1W<br>15-30 cm<br>B sub D | cf. small canid | Left mid-series rib, shaft fragment.<br>Freshly broken proximally and distally. |
| C-399 | A 1S1W<br>15-30 cm<br>B sub D | small mammal | Long bone shaft fragment, bounded by spiral fractures. |
| C-400 | A 1S1W<br>15-30 cm<br>B sub D | cf. *Bison bison* | Long bone shaft fragment, bounded by spiral fracture and fresh break. |
| C-401 | A 1S1W<br>15-30 cm<br>B sub D | cf. *Bison bison* | Rib shaft fragment, bounded by uneven spiral fractures.<br>Tooth-punctured. |
| C-402 | A 1S1W<br>15-30 cm<br>B sub D | large mammal | Long bone shaft fragment with spiral to ragged fractures and tooth-scoring. |
| C-403 | A 1S1W<br>15-30 cm<br>B sub D | large mammal | Flat bone fragment with spiral fractures. Possible tooth-scoring. |
| C-404 | A 1S1W<br>15-30 cm<br>B sub D | large mammal | Bone fragment, unidentifiable, bounded by spiral fractures. |
| C-405 | A 1S1W<br>15-30 cm<br>B sub D | large mammal | Bone fragment, unidentifiable, bounded by ragged fractures. |
| C-407 | A lSlW<br>15-30 cm<br>B sub D | large mammal | Bone fragment, unidentifiable, bounded by uneven to ragged fractures. |
| C-408 | A West Ext. | *Canis* sp. | Right mid-series rib, complete except for extreme distal end.<br>Distal end chewed to ragged margin with tooth-punctures. |
| C-409 | A West Ext. | ?*Bison bison* | Tiny cranial fragment, with uneven spiral fractures. |
| C-410 | A West Ext. | *Canis* sp. | Proximal phalanx, complete. |
| C-411 | A West Ext. | *Canis* sp. | Proximal phalanx, complete. |
| C-412 | A West Ext. | *Canis* sp. | Caudal vertebra, complete. |
| C-413 | A West Ext. | small canid | Right 1st metacarpal, complete. |
| C-414 | A West Ext. | *Canis* sp. | Caudal vertebra, complete. |
| C-415 | A West Ext. | *Canis* sp. | Caudal vertebra, complete. |
| C-416 | A West Ext. | *Canis* sp. | 2nd phalanx, complete. |
| C-417 | A West Ext. | *Canis* sp. | Caudal vertebra, complete. |
| C-418 | A West Ext. | *Canis* sp. | Caudal vertebra, complete. |
| C-419 | A West Ext. | *Canis* sp. | Caudal vertebra, complete. |
| C-420 | A West Ext. | *Bison bison* | Fetal thoracic neural spine, unfused to arch. Complete. |
| C-421 | A West Ext. | ungulate | Calcified costal cartilage. |
| C-422 | A West Ext. | *Bison bison* | Fetal left ulna, nearly complete. Minor distal snap-break. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| C-423 | A West Ext. | *Bison bison* | Fetal thoracic neural spine, unfused to arch. Complete. |
| C-424 | A West Ext. | *Bison bison* | Fetal mid-series rib, distal half. Snapped proximally and distally. |
| C-425 | A West Ext. | *Bison bison* | Fetal right premaxilla, complete. |
| C-426 | A West Ext. | ungulate | Calcified costal cartilage. |
| C-427 | A West Ext. | *Canis* sp. | a. Carpal, complete; tooth-punctured.<br>b. 2nd phalanx, complete, small canid<br>c. 1st metacarpal, right<br>d. 3rd phalanx, complete. |
| | | *Canis* sp. | Three caudal vertebrae (one is only an epiphysis, chewed). |
| | | *Bison bison* | a. Fetal molar, unerupted, fragment.<br>b. Thoracic vertebral centrum and two unfused arch fragments.<br>c. Four mid-series to posterior-series rib fragments. |
| C-428 | A 2S2W<br>10-20 cm<br>B D #2 | toad, cf.<br>*Bufo* sp. | Tibiofibula, complete. |
| C-429 | A 1S2W<br>20-30 cm<br>B D #2 | *Canis* sp. | 7 teeth, mostly complete: RI$_2$, LP$_2$, LP$_3$, RP$_4$, RM$_2$, RM$_3$, RP$^4$. |
| | | ?bird | Possible mandible fragment. |
| C-430 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Proximal caudal vertebra, complete. |
| C-431 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Proximal caudal vertebra, complete. |
| C-432 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Proximal caudal vertebra, complete. |
| C-433 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, complete. |
| C-434 | A 0S2W<br>10-20 cm<br>B D =2 | *Canis* sp. | Caudal vertebra, complete. |
| C-435 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, complete. |
| C-436 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, complete. |
| C-437 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, complete. |
| C-438 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Proximal phalanx, complete. Heavily chewed and eroded (partially digested). |

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| C-439 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | 2nd phalanx, complete. |
| C-440 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | Caudal vertebra, complete. |
| C-441 | A 0S2W<br>10-20 cm<br>B D #2 | *Canis* sp. | a. Caudal vertebra, distal half; bitten across at midshaft (ragged break).<br>b. Proximal caudal vertebra, chewed, tooth-punctured.<br>c. 2nd phalanx, complete. Heavily chewed and eroded (partially digested).<br>d. 2nd phalanx, complete.<br>e. 3rd phalanx, complete. |
| | | small canid | Right 3rd metatarsal IV, proximal end. Snapped by bite; tooth-punctured. |
| | ______ | *Canis* sp. | a. 5 tooth fragments.<br>b. 3 caudal vertebral epiphyses. |
| C-442 | A 0S2W<br>0-20 cm<br>B D #2 | mammal | Small bone fragment, unidentifiable. Uneven spiral fractures. |
| C-443 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | 2nd phalanx, complete. Tooth-scored. |
| C-444 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | 2nd phalanx, complete. |
| C-445 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal thoracic neural spine, unfused, complete. |
| C-446 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal thoracic neural spine, unfused, complete. |
| C-447 | A 0S2W<br>B D #2<br>0-20 cm | *Bison bison* | Fetal left mid-series rib, proximal four-fifths. Snapped distally. |
| C-448 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal metacarpal, unfused, complete. |
| C-449 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal ?lumbar neural arch, unfused half; complete. |
| C-450 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal metatarsal, unfused, complete. |
| C-451 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal left radius, proximal two-thirds. Chewed and snapped distally. |
| C-452 | A 0S2W<br>0-20 cm<br>B D #2 | *Bison bison* | Fetal right mid-series rib, distal half. Fresh proximal and distal breaks. |
| C-453 | A 0S2W<br>0-20 cm<br>B D #2 | *Canis* sp. | a. Sesamoid, complete.<br>b. Sesamoid, complete.<br>c. Partial right $P_4$.<br>d. Lumbar neural spine, raggedly snapped from arch. |

| Number | Provenience | Taxon | Description |
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| | ________ | *Bison bison* | 4 fetal mid-series ribs (2 left, 1 right) |
| | | microtine rodent | Right femur, missing distal epiphysis. |
| | | Pelecypod | 2 shell fragments, small, one with articular area. |
| | | cf. *Discus* sp. | Nearly complete shell. |
| C-454 | A 0S0W 20-30 cm | *Bison bison* | Left mid-series rib, midshaft two-thirds. Ragged snap proximally below tubercle with tooth-scoring. Ragged distal break with extensive tooth-puncturing and scoring. |
| C-455 | A 0S0W 20-30 cm | *Bison bison* | Right mid-series rib, distal one-quarter. Freshly broken proximally. Ragged damage on distal end, with tooth-punctures. |
| C-456 | A 0S0W 20-30 cm | *Bison bison* | Left mid-series rib, shaft fragment. Ragged proximal break below tubercle with tooth-punctures and scoring. Fresh break at midshaft. |
| C-457 | A 0S0W 20-30 cm | *Bison bison* | Right tibia, distal end and small portion of shaft. Uneven spiral fractures (intersecting); point of impact unclear. Some broken margins lightly polished by scavenger action. |
| C-458 | A 0S0W 20-30 cm | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged to uneven spiral break at base with depressed fractures and cleaver marks on right lateral face just above base. Distal end chewed; tooth-punctured. |
| C-459 | A 0S0W 20-30 cm | *Bison bison* | Left mid-series rib, distal one-half. Transverse snap at midshaft. Distal end lightly chewed. |
| C-460 | A 0S0W 20-30 cm | *Bison bison* | Left mid-series rib, complete except for head. Snapped just below tubercle. Tooth-scoring at midshaft. Distal end has ragged broken edge with tooth-punctures and scoring. |
| C-461 | A 1S2W 20-30 em | *Bison bison* | Right scapula, nearly complete. Both angles of vertebral border heavily chewed, ragged margins with tooth-punctures. Tooth-punctures and scoring on margin of glenoid fossa. |
| C-462 | A 0S0W 20-30 cm | *Bison bison* | Right mid-series rib, midshaft three-quarters. Ragged snap proximally. Fresh break distally. |
| C-463 | A 0S0W 20-30 cm | *Bison bison* | Right tibia, distal end and distal one-third of shaft. Spiral fracture below midshaft (intersecting fractures). Point of impact not evident. |
| C-464 | A 0S0W 20-30 cm | *Bison bison* | Proximal phalanx, complete. |
| C-465 | A 0S1W 20-30 cm | *Bison bison* | Distal end of left femur and distal one-third of shaft. Spiral to uneven spiral fracture below midshaft (intersecting fractures). Point of impact on lateral face just below midshaft. Distal area chewed and scooped; hollow above patellar grooves; and abrasion of epicondyles. |
| C-466 | A 0S0W 20-30 cm | *Bison bison* | Right lumbar pleurapophysis, snapped from arch. Proximal snap uneven spiral. Distal end ragged with tooth-punctures. |
| C-467 | A 0S0W 20-30 cm | *Bison bison* | Right metacarpal, distal half. Diagonal spiral fracture below midshaft. |
| C-468 | A 1S2W | *Bison bison* | Right mid-series rib, proximal half. Head lightly chewed. Diagonal uneven spiral fracture at midshaft. |
| C-469 | A 1S2W | *Bison bison* | Right mid-series rib, shaft fragment, freshly snapped proximally and distally. |
| C-470 | A 1S2W | *Bison bison* | Right mid-series rib, shaft fragment. Ragged proximal snap-break. Scattered single cut marks on outer curve. Uneven spiral break distally. |

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| C-471 | A 1S2W | *Bison bison* | Left femur, shaft fragment, bounded by spiral fractures. |
| C-472 | A 1S2W | *Bison bison* | Left mid-series rib, nearly complete. Head and tubercle chewed away, leaving ragged fracture with tooth-punctures. Distal end chewed to ragged edge with tooth-punctures. |
| C-473 | A 1S2W | *Bison bison* | Metatarsal shaft fragment, bounded by irregular spiral fractures. Scavenger tooth-scoring widespread. |
| C-474 | A 2S2W 10-20 cm B sub D | *Bison bison* | Left mid-series rib, midshaft fragment. Ragged proximalsnap-break with tooth-punctures. Scattered transverse cut marks on outer curve below area of tubercle. Freshly broken distally. |
| C-475 | A 1S1W 15-30 cm | *Bison bison* | Lumbar pleurapophysis (right), snapped from arch. Uneven spiral snap-break proximally. Light chewing of distal end with tooth-punctures. |
| C-476 | A 1S1W | *Bison bison* | Left mid-series rib, proximal two-thirds of shaft. Head and tubercle snapped away leaving ragged break with tooth-punctures. Freshly broken at midshaft. |
| C-477 | A 1S2W 20-30 cm | *Bison bison* | Thoracic neural spine, distal half. Ragged snap proximally. Distal end chewed, leaving ragged edge with tooth-punctures. |
| C-478 | A 1S2W | *Bison bison* | Tibia shaft fragment, bounded by uneven spiral fractures. Two possible crescentic points of impact may be "flaking" by scavenger carnassial. |
| C-479 | A 1S2W | cf. *Bison bison* | Long bone shaft fragment, bounded by uneven spiral fractures. |
| C-480 | A 1S2W | *Bison bison* | Rib midshaft fragment, with ragged fractures proximally and distally. |
| C-481 | A 1S2W | *Bison bison* | Right anterior-series rib, proximal one quarter. Head and tubercle extensively chewed, with tooth-punctures. Distal fracture ragged, with tooth-punctures and scoring. |
| C-482 | A 1S2W | *Bison bison* | Rib shaft fragment, freshly broken proximally. Ragged distal break with tooth-punctures. |
| C-483 | A 1S1W 15-30 cm | *Bison bison* | Rib distal shaft fragment (mid-series). Freshly broken proximally. Ragged distal margin with tooth-punctures. |
| C-484 | A 1S2W | *Bison bison* | Rib distal shaft fragment (mid-series). Freshly broken proximally. Ragged distal break. |
| C-485 | A 1S2W | *Bison bison* | Rib shaft fragment, small. Fresh proximal and longitudinal breaks. Ragged distal break. Scattered transverse cut marks on outer curve. Fragment is from curve not far below tubercle. |
| C-486 | A 1S2W | *Bison bison* | Rib shaft fragment (mid-series). Ragged proximal snap-break. Freshly broken distally. |
| C-487 | A 1S2W | *Bison bison* | Humerus shaft fragment with part of large muscle scar, bounded by uneven spiral fractures. |
| C-488 | A 1S2W baulk | *Bison bison* | Long bone (?radius) shaft fragment, bounded by uneven spiral fractures. Light polish along margin - scavenger licking? |
| C-489 | A 0S2W 10-20 cm | *Bison bison* | Left patella, nearly complete. Chewed on all major eminences, with scattered tooth-punctures. |
| C-490 | A 1S1W 15-30 cm | *Bison bison* | Tibia shaft fragment, bounded by spiral and irregular spiral fractures. |
| C-491 | A 1S1W 15-30 cm | *Bison bison* | Long bone shaft fragment, bounded by uneven spiral fractures. |
| C-492 | A 0S0W 20-30 cm | *Bison bison* | Right lateral malleolus, complete. Very light tooth-scoring. |
| C-493 | A 2S2W 20-30 cm | *Bison bison* | Mid-series rib, distal shaft fragment. Ragged proximal break. Ragged distal break with some fresh damage. |
| C-494 | A 0S0W 20-30 cm | *Bison bison* | Thoracic neural spine, distal fragment. Ragged proximal snap-break. Ragged distal margin. |

| Number | Provenience | Taxon | Description |
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| C-495 | A 0S0W 20-30 cm | *Bison bison* | Thoracic neural spine, juvenile, snapped from arch. Ragged proximal snap-break. Distal margin ragged and torn into longitudinal splinter. Tooth-punctures present. |
| C-496 | A 0S0W 20-30 cm | *Bison bison* | Long bone shaft fragment, bounded by spiral fractures. |
| C-497 | A 0S0W 20-30 cm | *Bison bison* | Rib shaft fragment, freshly broken. |
| C-498 | A 0S0W 20-30 cm | *Bison bison* | Long bone shaft fragment, bounded by uneven spiral fractures. |
| C-499 | A 0S0W 20-30 cm | *Bison bison* | Rib shaft fragment, bounded by spiral fractures. Limited tooth-scoring. |
| C-500 | A 0S0W 20-30 cm | *Bison bison* | Mid-series rib fragment, distal part of shaft. Freshly broken proximally. Distal end chewed to ragged margin. |
| C-501 | A 0S0W 20-30 cm | *Bison bison* | Proximal phalanx, distal fragment, bounded by uneven spiral fractures. |
| C-502 | A 0S0W 20-30 cm | *Bison bison* | Distal phalanx, complete. |
| C-503 | A 0S0W 20-30 cm | *Bison bison* | Right lateral malleolus, complete. Light tooth-scoring. |
| C-504 | A 0S0W 20-30 cm | *Bison bison* | Distal phalanx, nearly complete. Distal tip freshly broken away. |
| C-505 | A 0S0W 20-30 cm | *Bison bison* | Proximal phalanx, complete. Limited midshaft tooth-scoring. |
| C-506 | A 0S0W 20-30 cm | *Bison bison* | Thoracic neural spine, distal fragment. Proximal (midshaft) ragged fracture with tooth-punctures. Distal ragged edge with numerous punctures and tooth-scoring. |
| C-507 | A 0S0W 20-30 cm | *Bison bison* | Left patella, nearly complete. Chewed on all major eminences. Scattered tooth-punctures. |
| C-508 | A 0S0W 20-30 cm | *Bison bison* | Right posterior-series rib, distal half. Freshly broken proximally. Distal end chewed to ragged edge; some scoring above this. |
| C-509 | A 0S0W 20-30 cm | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged proximal edge with tooth-scoring. Distal end chewed to ragged margin with tooth-scoring. |
| C-510 | A 0S1W 15-25 cm | *Bison bison* | Right mid-series rib, distal two-thirds. Uneven spiral snap below area of tubercle. Distal end chewed to ragged edge with tooth-punctures. |
| C-511 | A 0S0W 20-30 cm | *Bison bison* | Right mid-series rib, distal fragment. Ragged snap-break proximally, freshly broken in places. Distal end chewed to ragged edge with tooth-punctures. |
| C-512 | A 0S0W 20-30 cm | *Bison bison* | Right mid-series rib, proximal shaft fragment, juvenile. Ragged proximal snap-break below area of tubercle. Ragged distal break. |
| C-513 | A 0S0W 20-30 cm | *Bison bison* | Left posterior-series rib, midshaft one-half. Fresh breaks proximally and distally. Local tooth-scoring on shaft. Widely scattered single cut marks on outer curve, transverse or oblique. |
| C-514 | A 0S0W 20-30 cm | *Bison bison* | Left mid-series rib, midshaft one-half. Freshly broken proximally. Ragged distal snap-break. |

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| C-515 | A 0S0W<br>20-30 cm | *Bison bison* | Right mid-series rib, midshaft three-quarters, juvenile.<br>Proximal ragged snap-break below area of tubercle. Ragged distal snap-break. |
| C-516 | A West Ext. | *Bison bison* | Fetal right humerus, complete diaphysis. Tiny. |
| C-517 | A West Ext. | bird, grouse-sized | Proximal head right humerus. |
| | | *Bison bison* | Fetal thoracic vertebral centrum, complete. |
| C-518 | Hearth #1<br>172 cm<br>below surface | cf. *Erethizon dorsatum* | Occipital fragment with left occipital condyle. |
| C-519 | Hearth #1<br>172 cm<br>below surface | cf. *Canis* sp. | Fragment distal shaft of ulna? |
| C-520 | Hearth #1<br>172 cm<br>below surface | *Bison bison* | Fetal left exoccipital with occipital condyle. |
| C-521 | Hearth #1<br>172 cm<br>below surface | ?*Canis* sp. | ?sternal element. |
| C-522 | Hearth #1<br>172 cm<br>below surface | small canid | a. Proximal phalanx, complete.<br>b. 2nd phalanx, complete<br>c. Distal phalanx, complete. |
| | | *Canis* sp. | a. Incisor, worn.<br>b. Broken premolar. |
| | | *Bison bison* | a. Fetal unerupted tooth fragments (2).<br>b. Vertebral arch fragment. |
| | | cf. *Lepus* sp. | Distal end of left ulna. |
| | | cf. pelecypod | Small shell fragment with brilliant mother-of-pearl color play. |
| | | unidentifiable | 3 bone fragments. |
| C-523 | Cutbank,<br>surface | *Canis* sp. | Left humerus, distal end. Freshly snapped above supratrochlear foramen. Eroded. |
| C-524 | Cutbank,<br>surface | bird, grouse-sized | Right ulna, proximal half and shaft fragment, burned black. |
| | | ?*Bison bison* | Small long bone shaft fragment, burned black. Uneven broken edges. |
| C-525 | A lSlW<br>15-30 cm | *Bison bison* | Right posterior-series rib, complete. About 25 transverse<br>cut marks on outer curve just below tubercle. Not a tool. |
| C-526 | A 0S2W<br>10-25 cm | *Canis* sp. | 2nd phalanx, complete. Heavily chewed and eroded (partially digested). |
| C-527 | A 0S2W<br>10-25 cm<br>B D #2 | *Canis* sp. | Proximal fragment (head, snapped above tubercle) of rib, right. |
| C-528 | A 0S2W<br>10-25 cm<br>B D #2 | *Canis* sp. | Heavily worn canine tooth. |
| C-529 | A 0S2W<br>10-25 cm<br>B D #2 | *Canis* sp. | Heavily worn $RI^3$. |

| Number | Provenience | Taxon | Description |
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| C-530 | A 0S2W<br>10-25 cm<br>B D #2 | *Canis* sp. | 2nd phalanx, complete. |
| C-531 | A 1S1W<br>15-30 cm | *Bison bison* | Right mid-series rib, nearly complete. Proximal snap, ragged, between head and tubercle. Distal end chewed to ragged edge. |
| C-532 | A 1S1W<br>15-30 cm | *Bison bison* | Right mid-series rib, nearly complete. Diagonal ragged proximal snap at tubercle with tooth-punctures. Distal end very little modified. |
| C-533 | A 1S1W<br>15-30 cm | *Bison bison* | Right mid-series rib, proximal two-thirds. Head snapped away well above tubercle. Scattered cut marks, transverse, at curve below tubercle (area of muscle scar). Uneven distal fracture. |
| C-534 | A 1S1W<br>15-30 cm | *Bison bison* | Left mid-series rib, distal two-thirds. Uneven spiralfracture proximally with tooth-scoring and polish from licking. Distal end chewed to ragged margin with tooth-punctures. |
| C-535 | A 1S1W<br>15-30 cm | *Bison bison* | Left mid-series rib, midshaft two-thirds. Uneven proximal snap-break. Scattered transverse cut marks on outer curve below area of tubercle. Distal end chewed to ragged margin with depressed fractures. |
| C-536 | A 1S1W<br>15-30 cm | *Bison bison* | Right mid-series rib, midshaft two-thirds. Ragged proximal snap-break. Scattered transverse cut marks on outer curve below area of tubercle. Uneven distal spiral fracture. |
| C-537 | A 1S1W<br>15-30 cm | *Bison bison* | Left mid-series rib, distal three-quarters, juvenile. Ragged proximal snap below head. Distal end chewed to ragged edge with tooth-punctures. |
| C-538 | A 1S1W<br>15-30 cm | *Bison bison* | Left mid-series rib, proximal two-thirds. Tubercle crushed, with tooth-puncture. Uneven spiral fracture distally. |
| C-539 | A 1S1W<br>15-30 cm | *Bison bison* | Lumbar pleurapophysis, left, snapped from arch. Ragged proximal snap with depressed fracture. Distal end heavily chewed to ragged edge with several tooth-punctures. |
| C-540 | A 1S1W<br>15-30 cm | *Bison bison* | Left tibia, juvenile, medial shaft fragment bounded by spiral fractures. Point of impact on posterior face at midshaft. |
| C-541 | A 1S1W<br>15-30 cm | *Bison bison* | Mid-series rib, distal shaft fragment. Uneven spiral fracture proximally with tooth-punctures. Fresh break distally. Scattered diagonal cut marks on outer curve. |
| C-542 | A 1S1W<br>15-30 cm | *Bison bison* | Lumbar pleurapophysis, right, snapped from arch. Ragged proximal break with tooth-scoring. Distal end lightly chewed to ragged edge. |
| C-543 | A 1S1W<br>15-30 cm | *Bison bison* | Left posterior-series rib, distal one-third. Uneven, proximal spiral break. Distal end chewed to ragged edge with tooth-punctures. |
| C-544 | A 1S1W<br>15-30 cm | *Bison bison* | Right tibia, distal end with short portion of shaft and longer tongue of medial face of shaft. Split longitudinally, then transversely above distal end. Uneven spiral fractures. |
| C-545 | A 1S1W<br>15-30 cm | *Bison bison* | Right tibia, midshaft one-third. Transverse andlongitudinal fractures proximally; uneven spiral fractures. Oblique spiral fracture distally. |
| C-546 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, proximal three-quarters. Head snapped away to leave ragged edge with tooth-punctures. Transverse cut marks on outer curve just below tubercle. Distal ragged snap-break. |
| C-547 | A 0S2W<br>10-20 cm | *Bison bison* | Left metacarpal, complete. |

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| C-548 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Thoracic neural spine, snapped from arch. Proximal ragged break with tooth-punctures and scoring. Spalling of shaft by chewing. Distal end chewed to irregular edge with tooth-punctures. Extensive striation and polish of anterior border, with striations running lengthwise - used as a knife? Some diagonal striations. Clearly a tool. |
| C-549 | A 0S1W<br>15-25 em<br>B D #2 | *Bison bison* | Right ulna, olecranon process, snapped transversely and longitudinally above semilunar notch. Tooth-scoring and punctures. |
| C-550 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right tibia, shaft fragment from anterior face.<br>Uneven spiral fractures, with sharp points polished by licking. |
| C-551 | A 0S1W<br>15-25 cm<br>B D #2 | *Canis* sp. | Left femur, shaft missing proximal and distal. Proximal end snapped away with heavy tooth-scoring of areaaround break. Distal end broken away with tongue of anterior shaft. Heavy tooth-scoring of area. |
| C-552 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right mid-series rib, distal three-quarters. Ragged proximal break with scoring. Tooth-scoring in other shaft areas. Distal end chewed to irregular edge with tooth-punctures. Scattered, mostly transverse cut marks on outer curve in midshaft area. |
| C-553 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left intermediate carpal, complete. |
| C-554 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left tibia, posteroexternal shaft fragment bounded by uneven spiral fractures. |
| C-555 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Frontal fragment, juvenile, with base of horn core. |
| C-556 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left anterior-series rib, distal one-third. Ragged snap proximally.<br>Distal end chewed to ragged margin with tooth-punctures. |
| C-557 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right tibia, posteromedial shaft fragment, bounded by spiral fractures.<br>Heavily tooth-scored proximally. |
| C-558 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right tibia, posteromedial shaft fragment, bounded by spiral fractures. |
| C-559 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Distal half of thoracic neural spine, with ragged proximal break.<br>Distal end chewed to ragged margin with tooth-punctures.<br>Leading edge polished and exhibits lengthwise striations from use on both faces - a knife? |
| C-560 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, shaft fragment, Ragged proximal break.<br>Some spalling (chewing) of edge of shaft. Ragged distal break. |
| C-561 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, shaft fragment. Ragged proximal and distal breaks. |
| C-562 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged proximal snap-break.<br>Distal end chewed into raggedmargin with splinters extending proximally along both margins. Two diagonal cut marks on right face. |
| C-563 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | 2nd phalanx, complete. |

| Number | Provenience | Taxon | Description |
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| C-564 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, medial one-third.<br>Uneven spiral fracture proximally. Freshly snapped distally. |
| C-565 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Scapular blade fragment, bounded by snap breaks. |
| C-566 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right mid-series rib, distal two-thirds. Ragged proximal snap-break.<br>Distal end chewed to ragged margin, with local tooth-scoring. |
| C-567 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, proximal one-third. Uneven spiral break between head and tubercle.<br>Tubercle crushed, with tooth-punctures around damaged area. Fresh break distally. |
| C-568 | A lS0W<br>15-30 cm | *Bison bison* | Right mid-series rib, proximal one-fifth. Uneven spiral fracture between head and tubercle.<br>Tooth-punctures on tubercle. Transverse cut marks on outer curve below area of tubercle.<br>Ragged distal snap-break. |
| C-569 | A lS0W<br>15-30 cm | *Bison bison* | Right mid-series rib, distal one-fifth. Ragged snap-break proximally.<br>Distal end chewed to uneven margin with tooth-punctures. |
| C-570 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right mid-series rib, distal one-third. Ragged proximal snap-break.<br>Distal end chewed to ragged margin with tooth-punctures. |
| C-571 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Thoracic neural spine, distal half. Ragged proximal snap with depressed fractures and tooth-scoring. Distal end heavily chewed to ragged margin with tooth-punctures and scoring. |
| C-572 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, midshaft one-third.<br>Uneven proximal spiral snap. Fresh distal break. |
| C-573 | A 0S1W<br>15-25 cm<br>B D 42 | *Bison bison* | Right mid-series rib, midshaft fragment.<br>Uneven proximal spiral snap. Uneven distal snap break. |
| C-574 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Proximal sesamoid. |
| C-575 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Proximal sesamoid. |
| C-576 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Proximal sesamoid. |
| C-577 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Proximal sesamoid. |
| C-578 | A 0S2W<br>10-20 cm | *Bison bison* | Right ulna and radius, distal end, with jagged, unevenspiral fracture two-thirds of the way down shaft. Point of impact not clear.<br>Portions of broken edge rounded from licking by scavenger. |
| C-579 | A 0S2W<br>10-20 cm | *Bison bison* | Left tibia, distal end, with jagged, uneven spiral fracture two-thirds of the way down shaft. Point of impact not clear. Part of fracture follows split-line cracks. Portions of broken edge rounded from licking by scavenger. |

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| C-580 | A 0S2W<br>10-20 cm | *Bison bison* | Left posterior-series rib, proximal one-half. Uneven snap break between head and tubercle. Distal ragged break with tooth-punctures. |
| C-581 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged proximal snap with cleaver blows on left face near base. Scavenger chewing evident on nearby margin. Distal end chewed to ragged margin. |
| C-582 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged proximal snap with cleaver blows low on left face. Tooth-scoring evident nearby. Distal end chewed to ragged margin. |
| C-583 | A 0S2W<br>10-20 cm | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged to uneven proximal snap break. Small cleaver mark on left face near break. Distal end chewed to ragged margin. |
| C-584 | A 0S2W<br>10-20 cm | *Bison bison* | Lumbar pleurapophysis, snapped from arch. Ragged to uneven spiral break proximally. Snapped at mid-length with longitudinal splinters, distal area ragged and tooth-punctured. |
| C-585 | A 0S2W<br>10-20 cm | small ungulate | Right tibia, immature, long shaft fragment including epiphyseal plate in part. Posteromedial fragment, split longitudinally. Tooth-scoring and crescentic spalling along broken margin. Fragment bounded by uneven spiral fractures. |
| C-586 | A 0S2W<br>10-20 cm | *Bison bison* | Humerus, shaft fragment, bounded by uneven spiral fractures. Some broken margins polished by scavenger licking. |
| C-587 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Rib, shaft fragment (external shaft splinter, freshly split).Fresh proximal and distal breaks. Cluster of 10 transverse cut marks on outer curve. |
| C-588 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right tibia, external shaft fragment, bounded by spiral fractures. Localized tooth-scoring and minor crescentic spalling of margin. |
| C-589 | A 0S2W<br>10-20 cm | *Bison bison* | Left mid-series rib, distal shaft fragment. Unevenspiral break proximally. Distal end chewed to ragged margin with tooth-punctures. |
| C-590 | A lS0W<br>15-30 cm | *Bison bison* | Rib shaft fragment, freshly broken proximally and distally. |
| C-591 | A 2S1W | *Bison bison* | Rib shaft fragment, freshly broken at one end and uneven spiral fracture at other. Freshly split. Eight slightly oblique to transverse cut marks on outer curve. |
| C-592 | A 2S1W | *Bison hison* | Juvenile right temporal, nearly complete, with periotic. Anterior portions snapped away. Localized tooth-punctures and breakage of cancellous areas. |
| C-593 | A 2S1W | *Bison bison* | Right mid-series rib, nearly complete. Ragged proximal snap just below tubercle with tooth-scoring. Distal end chewed to ragged margin with tooth-punctures. |
| C-594 | A 2S1W | *Bison bison* | Left mid-series rib, juvenile, nearly complete. Ragged proximal snap just below tubercle. Distal end freshly broken. |
| C-595 | A 2S1W | *Bison bison* | Thoracic neural spine, snapped from arch. Uneven proximal spiral break with cleaver marks on right face. Distal end chewed to ragged margin with tooth-punctures. |
| C-596 | A 2S1W | *Bison bison* | Right posterior-series rib, distal half. Spiral fracture proximally, becoming longitudinal crack. Three punctures present along the crack on the outer curved face; two are tooth-punctures and the other contains a grey quartzite flake or point tip. Localized tooth-scoring. Transverse and oblique cut marks on external face just above distal end. Distal end chewed to ragged margin with tooth-punctures. |
| C-597 | A 2S1W | *Bison bison* | Femur shaft fragment, bounded by uneven spiral fractures. |
| C-598 | A 2S1W | *Bison bison* | Left mid-series rib, distal shaft fragment. Uneven proximal spiral fracture. Minor transverse cut mark on external face just above distal end. Local tooth-scoring of shaft. Distal end chewed to ragged margin with tooth-punctures. |
| C-599 | A 2S1W | *Bison bison* | Left mandible, ventral fragment of lingual wall, horizontal ramus, bounded by ragged to uneven spiral fractures. Nine vertical cut marks near ventral angle. |

| Number | Provenience | Taxon | Description |
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| C-600 | A 2S1W | *Bison bison* | Anterior-series rib, juvenile, distal fragment. Distal break with development of pseudoarthrosis. Ragged proximal break. Extensive tooth-puncturing. |
| C-601 | A 2S1W | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged proximal snap-break. Distal end chewed to ragged edge, with tooth-punctures. |
| C-602 | A 2S1W | *Bison bison* | Femur shaft fragment, bounded by spiral fractures. |
| C-603 | A 2S1W | *Bison bison* | Right tibia, posteromedial shaft fragment, bounded hy spiral fractures. Five cleaver blows evident on posterior face. |
| C-604 | A 2S1W | *Bison bison* | Radius, anterior shaft fragment, bounded by spiral fractures. |
| C-605 | A 2S1W | *Bison bison* | Right tibia, medial shaft fragment, bounded by spiral fractures. |
| C-606 | A 2S1W | *Bison bison* | Right mid-series rib, shaft fragment. Ragged proximal and distal fractures. |
| C-607 | A 2S1W | *Bison bison* | Mid-series rib, distal shaft fragment. Ragged proximal and distal fractures with tooth-punctures. |
| C-608 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right mid-series rib, nearly complete. Ragged proximal snap just below tubercle. Distal end chewed to ragged margin with tooth-punctures. |
| C-609 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, nearly complete. Ragged proximal snap just below tubercle, with tooth scoring. Distal end chewed to uneven margin. |
| C-610 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, nearly complete. Ragged, splintered proximal shaft break with tooth-punctures. Distal end chewed to ragged margin with tooth-punctures. |
| C-611 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, nearly complete. Uneven proximal spiral break. Distal end chewed to uneven margin. |
| C-612 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left posterior-series rib, nearly complete. Head chewed or otherwise damaged slightly. Distal end lightly chewed to uneven margin with tooth-punctures. |
| C-613 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged proximal snap. with cleaver mark on right face near base. Distal end chewed to ragged margin with scalloped edge. |
| C-614 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Proximal phalanx, complete. |
| C-615 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Radius, distal shaft fragment, bounded by uneven spiral fractures. Single transverse cut mark on angle between posterior and ?medial face. |
| C-616 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, distal one-fifth. Ragged snap proximally. Distal end chewed to ragged margin with tooth-punctures. |
| C-617 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right posterior-series rib, distal one-quarter. Ragged proximal snap-break. No distal damage. |
| C-618 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Radius, shaft fragment, bounded by spiral fractures. |

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| C-619 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left magnum carpal, complete. |
| C-620 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left tibia, distal half, spirally fractured at midshaft from point of impact on antero-external aspect at midshaft. |
| C-621 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Tibia shaft fragment, bounded by spiral fractures. |
| C-622 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Femur shaft fragment, bounded by uneven spiral fractures. Crescentic scars from scavenger teeth, and polish from licking. |
| C-623 | A 0S1W<br>15-25 cm | *Bison bison* | Right tibia, posteroexternal shaft fragment, proximal half of shaft, bounded by spiral to uneven spiral fractures. Localized tooth-scoring. |
| C-624 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Thoracic neural spine, juvenile, snapped from arch. Ragged proximal snap. Limited distal damage with splintering. |
| C-625 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Left ulnar carpal, complete. |
| C-626 | A 0S1W<br>15-25 cm<br>B D #2 | small ungulate | Right mid-series rib, midshaft fragment. Uneven snap-break proximally. Ragged distal break with tooth-punctures. |
| C-627 | A 0S1W<br>15-25 cm<br>B D #2 | *Bison bison* | Right lateral malleolus, complete. |
| C-628 | A 0S1W<br>15-25 cm<br>B D t2 | *Bison bison* | Proximal series rib, distal half. Ragged snap proximally and incomplete levered snap in middle of fragment. Distal end chewed to ragged margin. |
| C-629 | A 0S0W<br>20-30 cm | *Bison bison* | Left femur, midshaft one-third, posterior face, bounded by spiral fractures. Two crescentic scars mark points of impact on lateral face. |
| C-630 | A 0S0W<br>20-30 cm | *Bison bison* | Left mid-series rib, midshaft one-third. Uneven proximal spiral break with tooth-puncture. Limited scoring of shaft. Distal end chewed to ragged margin with tooth-scoring. |
| C-631 | A 0S2W<br>15-25 cm<br>B D #2 | *Bison bison* | Left mid-series rib, juvenile, distal one-fifth of shaft.Ragged proximal snap-break. Distal end chewed to ragged margin. |
| C-632 | A 0S0W<br>20-30 cm | *Bison bison* | Right mid-series rib, shaft fragment. Uneven spiral proximal break. Ragged distal break. Partly scorched. |
| C-633 | A 0S1W<br>15-20 cm<br>B D #2 | *Bison bison* | Distal phalanx, proximal half. Looks scorched. |
| C-634 | No Prov | cf. *Bison bison* | Long bone shaft fragment, bounded by uneven spiral fractures. |
| C-635 | A 0S0W<br>15-30 cm<br>B sub D | *Bison bison* | Right posterior-series rib, proximal shaft fragment with part of tubercle. Freshly broken proximally and longitudinally and ragged distal break. |
| C-636 | A 0S0W<br>15-30 cm<br>B sub D | *Canis* sp. | Right premaxilla, disarticulated from skull. Edentulous. |

| Number | Provenience | Taxon | Description |
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| C-637 | A 0S0W<br>15-30 cm<br>B sub D | cf. *Bison bison* | Long bone shaft fragment, bounded by fresh breaks and uneven spiral fractures. |
| C-638 | A 0S0W<br>15-30 cm<br>B sub D | cf. *Bison bison* | Long bone shaft fragment, bounded by spiral fractures. |
| C-639 | A 0S0W<br>15-30 cm<br>B sub D | cf. *Bison bison* | Rib shaft fragment, bounded by uneven spiral and ragged longitudinal fractures. |
| C-640 | A 0S0W<br>15-30 cm<br>B sub D | *Canis* sp. | Fragment of canine tooth. |
| C-641 | A 0S0W<br>15-30 cm<br>B sub D | *Bison bison* | Right posterior-series rib, proximal shaft fragment.<br>Ragged proximal snap at tubercle with tooth-punctures. Uneven spiral distal break. |
| C-642 | B 0S0W<br>43 cm<br>18S 110W | *Bison bison* | Distal half of left metacarpal. Uneven spiral fracture at midshaft. |
| C-643 | B 0S0W<br>39 cm<br>71S 10W | *Bison bison* | Left mid-series rib, distal one-quarter. Fresh snapproximally.<br>Transverse cut mark on outer curve 5 cm above distal end chewed and splintered to uneven margin. |
| C-644 | B 0S0W<br>43 cm<br>14S 72W | *Bison bison* | Radius, shaft fragment, bounded by spiral fractures. Three crescentic scars along ?lateral margin; look like impacts, but are associated with localized tooth-scoring. |
| C-645 | B 0S0W<br>40 cm<br>73S 10W | *Bison bison* | Left mid-series rib, midshaft one-quarter.<br>Ragged proximal break and ragged to uneven spiral distal break. |
| C-646 | B 0S0W<br>43.5 cm<br>170S 47W | *Bison bison* | Left mandible, portion of horizontal ramus and ascending ramus.<br>Ventral half of horizontal ramus broken away; ascending ramus truncated vertically ahead of coronoid process. $M_2$, $M_3$ present; in full wear. |
| C-647 | Cutbank, surface | *Canis* sp. | Left posterior rib, nearly complete. Distal end chewed to ragged edge. |
| C-648 | Cutbank, surface | *Antilocapra americana* | Left humerus, distal half. Uneven spiral fracture at midshaft with crescentic scar on posterior face at midshaft. Widespread tooth-punctures and scoring around midshaft break; distal end tooth-scored and rodent-gnawed. |
| C-649 | Cutbank, surface | *Bison bison* | Right mandible, ascending ramus, snapped diagonally behind $M_3$.<br>Minor damage to tip of coronoid process. Ragged broken edge along base of ramus. |
| C-650 | Cutbank, surface | *Bison bison* | Left ischium and pubis with acetabulum. Ragged spiral break of iliac ramus just ahead of acetabulum. Tuber ischii snapped away leaving ragged break with tooth-punctures.<br>Ventral bar of pubis snapped away. |
| C-651 | Cutbank, surface | *Bison bison* | Right scapula; glenoid, neck and one-third of blade. Scorched medially.<br>Ragged break across blade; spine snapped away with limited tooth-scoring. |
| C-652 | Cutbank, surface | *Bison bison* | Right $M^3$, complete except for one root. In full wear; entostyle just worn on tip. |
| C-653 | Cutbank, surface | *Bison bison* | Left $M^2$, incomplete. In full wear. |

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| C-654 | Cutbank, surface | *Bison bison* | Left astragalus, complete. |
| C-655 | Cutbank, surface | *Bison bison* | Left humerus, missing proximal articular end. Proximal break scalloped, with tooth-scoring. |
| C-656 | Cutbank, surface | *Bison bison* | Right ulna, missing olecranon epiphysis and distal end. Broken olecranon margin is chewed to ragged edge with tooth-scoring. Distal end snapped, with spiral fracture. |
| C-657 | Cutbank, surface | *Bison bison* | Left radius, proximal half, with tongue of material removed proximally on anterior face. Uneven spiral fracture. Crescentic scars on one broken edge directly associated with tooth-scoring and scars on opposite edge. |
| C-658 | Cutbank, surface | *Bison bison* | Right humerus, missing proximal articular end. Proximal break uneven spiral to scalloped, with tooth-scoring. |
| C-659 | Cutbank, surface | *Bison bison* | Right radius, proximal half, with uneven spiral fracture at midshaft. Subadult? |
| C-660 | Cutbank, surface | *Bison bison* | Right radius, distal half, with uneven spiral fracture at midshaft. Does not fit C-659. Distal epiphysis unfused and not present. |
| C-661 | Cutbank, surface | *Bison bison* | Right tibia, missing proximal articular surface. Ragged to scalloped proximal broken edge. |
| C-662 | Cutbank, surface | *Bison bison* | Left tibia, missing proximal articular surface. Ragged to scalloped proximal broken edge with heavy tooth-scoring. |
| C-663 | Cutbank, surface | *Bison bison* | Left ulna and radius, distal half. Spiral fracture at mid-shaft with tongue extending down anterior face. Area of impact marked by crescentic scars on anteroexternal aspect below midshaft. Tooth-scoring associated with break. Distal end scorched. |
| C-664 | Cutbank, surface | *Antilocapra americana* | Left metatarsal, distal two-thirds. Ragged transverse breakabove midshaft with tooth-scoring. Distal end shows tooth-scoring and punctures, both on condyles and in area of epiphyseal plate. |
| C-665 | Cutbank, surface | cf. *Antilocapra* | Left tibia, posterior half of proximal one-third, including *americana* proximal articular end. Uneven spiral fracture with crescentic retouch and tooth-scoring. Proximal end scored and tooth-punctured. |
| C-666 | Cutbank, surface | *Bison bison* | Distal phalanx, complete. |
| C-667 | Cutbank, surface | *Canis* sp. | Left scapula, posterior border of blade. Uneven snapped margins. |
| C-668 | Cutbank, surface | *Bison bison* | Right naviculo-cuboid, subadult, complete. |
| C-669 | Cutbank, surface | *Bison bison* | Right magnum carpal, complete. |
| C-670 | Cutbank, surface | *Bison bison* | 2nd phalanx, complete. |
| C-671 | Cutbank, surface | *Bison bison* | Right naviculo-cuboid, complete. |
| C-672 | Cutbank, surface | *Bison bison* | Left ulnar carpal, complete. |
| C-673 | Cutbank, surface | *Bison bison* | Distal phalanx, complete. |
| C-674 | Cutbank, surface | *Bison bison* | Left radial carpal, complete. |

| Number | Provenience | Taxon | Description |
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| C-675 | Cutbank, surface | *Bison bison* | Right ulnar carpal, complete. |
| C-676 | Cutbank, surface | *Bison bison* | Right maxilla fragment with $P^4$-$M^3$, in full wear. Uneven snapped edge above teeth; uneven snapped edge on palate. $M^1$ has a small interfossette. |
| C-677 | Cutbank, surface | *Bison bison* | Left mandible, subadult, with $dP_{3-4}$ and $M_{1-3}$. M1 in full wear except ectostylid. $M_2$ almost to level of $M_1$ ,but unworn. Crown polished. $M_3$ unerupted in bud. Uneven spiral fracture diagonally from diastema down to a point below $dP_4$. Gonial angle chewed to ragged edge with tooth-puncture, |
| C-678 | Cutbank, surface | *Bison bison* | Left maxilla fragment with $DP^{3-4}$ and $M^{1-2}$. May be counterpart to C-677, $M^1$ in full wear, but light on VII-VIII. $M^2$ not yet to level of $M^1$; unworn. Margin of $M^3$ alveolus shows that $M^3$ was forming in bud. Ragged dorsal broken margin of maxilla with tooth-scoring. Palatal margin freshly broken. |
| C-679 | Cutbank, surface | *Bison bison* | Right maxilla fragment with $M^{1-2}$, both in full wear. Ragged dorsal broken margin at level of roots. Ragged palatal broken margin. |
| C-680 | A lSlW 15-30 cm B sub D | *Bison bison* | Right maxilla and premaxilla, juvenile, with $DP^{2-4}$ and $M^1$. $DP^4$ crown broken, apparently in full wear. $M^1$ erupted partly; unworn. Dorsal margin of maxilla broken at level of roots. Ragged palatal broken margin. |
| C-681 | A lSlW 15-30 cm B sub D | *Bison bison* | Two fragments of $M^2$ and small maxilla fragment from C-680. |
| C-682 | Hearth #1 172 cm | *Bison bison* | Anterior-series rib, distal one-third, ?right. Ragged proximal snap. Distal end chewed to uneven margin with tooth-punctures. |
| C-683 | Hearth #1 172 cm | *Bison bison* | Mid-series rib, midshaft one-quarter, ?right. Uneven spiral proximal fracture. Ragged distal fracture. |
| C-684 | Hearth #1 172 cm | *Bison bison* | Metatarsal, full-term fetal or neonatal, posterior midshaft fragment. Bounded by uneven spiral fractures. |
| C-685 | Hearth #1 172 cm | *Bison bison* | Left mid-series rib, midshaft fragment. Freshly broken proximally. Uneven spiral distal snap. |
| C-686 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, distal three-quarters of shaft. Uneven spiral snap proximally below area of tubercle. Limited tooth-scoring of shaft. Distal end chewed to ragged margin with tooth-punctures and splintering. Diagonal cut mark on outer curve just above distal end. |
| C-687 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, midshaft one-third. Ragged proximal snap with cracks running down shaft. Ragged distal break with splinters running up both edges. Eleven transverse, short cut marks on outer curve at about midshaft. |
| C-688 | Hearth #1 172 cm | *Bison bison* | Right anterior-series rib, juvenile, midshaft one-half. Ragged proximal snap-break. Ragged distal break. |
| C-689 | Hearth #1 172 cm | *Bison bison* | Right posterior-series rib, proximal half. Ragged snap between head and tubercle, with tooth-punctures. Ragged distal break. |
| C-690 | Hearth #1 172 cm | *Bison bison* | Left mid-series rib, shaft fragment, split longitudinally. Ragged proximal break in region of tubercle. Spiral fracture distally above midshaft. |
| C-691 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, shaft fragment. Ragged proximal snap just below tubercle. Ragged distal fracture above midshaft. |

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| C-692 | Hearth #1<br>172 cm | *Bison bison* | Right ulna, missing olecranon epiphysis and extreme distal end.<br>Area of olecranon epiphysis chewed away, leaving ragged margin with tooth-scoring.<br>Minor tooth-scoring at midshaft. Freshly broken distally. |
| C-693 | Hearth #1<br>172 cm | *Bison bison* | Right posterior-series rib, distal one-third. Fresh break proximally.<br>Distal end lightly damaged, with some tooth-scoring. |
| C-694 | Hearth #1<br>172 cm | *Bison bison* | Left patella, nearly complete. Lateral eminence broken away and ventral eminence chewed away; shows tooth-punctures. |
| C-695 | Hearth #1<br>172 cm | *Bison bison* | Distal phalanx, complete. |
| C-696 | Hearth #1<br>172 cm | *Bison bison* | Left mid-series rib, distal one-fifth. Ragged proximal snap-break.<br>Distal end chewed to ragged margin with tooth-punctures. |
| C-697 | Hearth #1<br>172 cm | *Bison bison* | Left astragalus, complete. |
| C-698 | Hearth #1<br>172 cm | *Bison bison* | Left posterior-series rib, distal half. Freshly broken proximally.<br>Distal end freshly damaged. |
| C-699 | Hearth #1<br>172 cm | *Bison bison* | Left naviculo-cuboid, complete. Articulates with C-697. |
| C-700 | Hearth #1<br>172 cm | *Bison bison* | Left intermediate carpal, complete. |
| C-701 | Hearth #1<br>172 cm | *Bison bison* | Left mid-series rib, juvenile, proximal one-third.<br>Four transverse cut marks on inner curve below tubercle. Freshly broken distally. |
| C-702 | Hearth #1<br>172 cm | *Bison bison* | Rib shaft fragment, split longitudinally. Uneven spiral fractures. |
| C-703 | Hearth #1<br>172 cm | *Bison bison* | Left mid-series rib, distal one-fifth. Freshly broken proximally.<br>Distal end chewed to ragged margin with tooth-puncture and scoring. |
| C-704 | Hearth #1<br>172 cm | *Bison bison* | Left mid-series rib, distal one-third. Freshly broken proximally.<br>Distal end chewed to ragged margin with heavy tooth-scoring and punctures. |
| C-705 | Hearth #1<br>172 cm | *Bison bison* | Radius, shaft fragment, bounded by spiral fraectures.<br>Localized tooth-scoring, and one edge has series of crescentic spalls. |
| C-706 | Hearth #1<br>172 cm | *Bison bison* | Right proximal series rib, distal one-third. Fresh break proximally.<br>Tooth-scoring on shaft. Distal end chewed to ragged margin with tooth-punctures. |
| C-707 | Hearth #1<br>172 cm | *Bison bison* | Proximal phalanx, complete. Epiphyseal line still visible.<br>Tooth-punctures adjacent to distal end. |
| C-708 | Hearth #1<br>172 cm | *Bison bison* | Right radius, proximal one-quarter with articular end.<br>Uneven spiral fracture well above midshaft. |
| C-709 | Hearth #1<br><br>172 cm | *Bison bison* | Right mid-series rib, midshaft two-thirds. Uneven spiral break proximally below tubercle,<br>with crescentic spalls and light scoring. Fresh break distally. |
| C-710 | Hearth #1<br>172 cm | ?*Bison bison* | Mid-series rib, juvenile, distal one-third. Freshly broken proximally.<br>Ragged distal break with splintering and tooth-punctures. (?*Antilocapra*). |
| C-711 | Hearth #1<br>172 cm | *Bison bison* | Left radius, distal one-third, with distal end of ulna.<br>Uneven spiral fracture below midshaft. |
| C-712 | Hearth #1<br>172 cm | *Bison bison* | Right mid-series rib, distal two-thirds. Fresh break proximally.<br>Light scoring of shaft. Distal end chewed to ragged margin with tooth-punctures. |

| Number | Provenience | Taxon | Description |
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| C-713 | Hearth #1 172 cm | *Bison bison* | Left mid-series rib, proximal one-third. Freshly broken distally. |
| C-714 | Hearth #1 172 em | *Bison bison* | Left metatarsal, proximal one-third with articular end. Articulates with C-699. Uneven spiral fracture just below proximal end. |
| C-715 | Hearth #1 172 cm | *Bison bison* | Left tibia, proximal shaft fragment, posteroexternal. Uneven spiral fractures; proximal broken edge scalloped with heavy tooth-scoring. |
| C-716 | Hearth #1 172 cm | *Bison bison* | Thoracic neural spine, snapped from arch. Ragged break at base with cleaver mark on left face at break. Distal end chewed to ragged margin with tooth-punctures. |
| C-717 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, distal one-third. Fresh break proximally. Distal end chewed to ragged margin, with tooth-punctures. |
| C-718 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, distal one-quarter. Fresh break proximally. Distal end chewed to ragged margin, with tooth-punctures. |
| C-719 | Hearth #1 172 cm | *Bison bison* | Tibia shaft fragment, bounded by spiral fractures. |
| C-720 | Hearth #1 172 cm | *Bison bison* | Left mid-series rib, midshaft one-third. Ragged proximal break, with heavy tooth-scoring and punctures. Fresh break distally. |
| C-721 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, midshaft fragment. Ragged proximal break. Fresh break distally. |
| C-722 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, distal fragment. Freshly broken proximally. Distal end chewed to ragged distal margin, with tooth-punctures. |
| C-723 | Hearth #1 172 cm | *Bison bison* | Left mid-series rib, midshaft fragment. Freshly broken proximally and distally. |
| C-724 | Hearth #1 172 cm | *Bison bison* | Left mid-series rib, distal fragment. Freshly broken proximally. Distal end chewed to ragged margin with tooth-punctures and splinter running up leading edge of shaft. |
| C-725 | Hearth #1 172 cm | *Bison bison* | Left mid-series rib, juvenile, distal half. Freshly broken proximally. Distal end chewed to ragged margin with tooth-scoring. |
| C-726 | Hearth #1 172 cm | *Bison bison* | Left trapezoid carpal, complete. |
| C-727 | Hearth #1 172 cm | *Bison bison* | Left intermediate carpal, complete. |
| C-728 | Hearth #1 172 cm | *Bison bison* | Right radius, distal half, and distal end of right ulna. Uneven spiral fracture at midshaft. |
| C-729 | Hearth #1 172 cm | *Bison bison* | Right mid-series rib, shaft fragment, split longitudinally. Spiral fractures proximally and distally - both on curve below tubercle. |
| C-730 | Hearth #1 172 cm | *Bison bison* | Tibia shaft fragment, bounded by uneven spiral fractures. |
| C-731 | Hearth #1 172 cm | cf. *Bison bison* | Small rib shaft fragment, split longitudinally. Uneven spiral fracture proximally below tubercle. Distal end freshly broken. |
| C-732 | Hearth #1 172 cm | *Bison bison* | Left ulnar carpal, complete. |
| C-733 | Hearth #1 172 cm | *Bison bison* | Left scaphoid carpal, complete. |

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| C-734 | Hearth #1<br>172 cm | *Bison bison* | Left trapezoid carpal, complete. Articulates with C-732. |
| C-735 | Hearth #1 | ?*Bison bison* | Long bone shaft fragment, small, bounded by uneven spiral fractures. |
| C-736 | Hearth #1<br>172 cm | *Bison bison* | Distal shaft fragment of left ulna. Fits C-711. Spiral fracture proximally; fresh break distally. |
| C-737 | Hearth #1<br>172 em | cf. *Bison bison* | Long bone shaft fragment, bounded by uneven spiral fractures. |
| C-738 | Hearth #1<br>172 cm | *Bison bison* | Left metacarpal, proximal one-quarter with articular surface.<br>Spiral fracture well above midshaft, cross-cutting several transverse cutmarks on anterior median about one-quarter of the way downshaft. Articulates with C-746 and C-734. |
| C-739 | Hearth #1<br>172 cm | *Bison bison* | Proximal phalanx, complete. |
| C-740 | Hearth #1<br>172 cm | *Bison bison* | 2nd phalanx, complete. |
| C-741 | Hearth #1<br>172 cm | cf. *Bison bison* | Long bone shaft fragment, bounded by uneven spiral fractures.<br>Tooth-scoring at one end. |
| C-742 | Hearth #1<br>172 cm | *Bison bison* | Rib, small shaft fragment, freshly broken. |
| C-743 | Hearth #1<br>172 cm | *Bison bison* | Rib, small shaft fragment, uneven spiral fractures and fresh longitudinal break. |
| C-744 | Hearth #1<br>172 cm | cf. *Bison bison* | Long bone shaft fragment, bounded by uneven spiral fractures. |
| C-745 | Hearth #1<br>172 cm | *Bison bison* | Left intermediate carpal, complete. Articulates with C-746, C-738, and C-734. |
| C-746 | Hearth #1<br>172 cm | *Bison bison* | Left magnum carpal, complete. Articulates with C-745, C-738, and C-734. |
| C-747 | Hearth #1<br>172 cm | *Bison bison* | 7th cervical vertebra, with neural spine and posteroventralportion of centrum broken away. Ragged to uneven spiral fracture at base of spine. Ragged broken edge on centrum with tooth-punctures. Postzygapophyses show tooth-scoring. |
| C-748 | Hearth #1<br>172 cm | *Bison bison* | Rib, small shaft fragment bounded by ragged and uneven spiral fractures.<br>Tooth-scored on shaft surface. |
| C-749 | Hearth #1<br>172 cm | *Bison bison* | Proximal sesamoid, complete. Heavily chewed and eroded (partially digested). |
| C-750 | Hearth #1<br>172 cm | ?*Bison bison* | Small bone fragment (?carpal), bounded by irregularspiral fractures. |
| C-751 | Hearth #1<br>172 cm | *Bison bison* | Calcified rib cartilage, heavily chewed and tooth-punctured. |
| C-752 | A lS2W<br>Baulk | *Bison bison* | Left femur, juvenile, midshaft fragment from posterior face. Uneven spiral fractures with polish from scavenger licking along edges. Heavy distal tooth-scoring. |
| C-753 | "sluff" | *Bison bison* | Right mid-series rib, shaft fragment, split longitudinally.<br>Ragged breaks proximally and distally. |
| C-754 | A lS2W<br>Baulk | *Bison bison* | Right mid-series rib, small shaft fragment, bounded by uneven spiral fractures. |
| C-755 | A lS2W<br>Baulk | *Bison bison* | Right innominate, fragment of iliac ramus from area of acetabulum.<br>Ragged fractures on all sides, with tooth-scoring and punctures. |

| Number | Provenience | Taxon | Description |
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| C-756 | A lS2W Baulk | *Bison bison* | Tip of horn core, subadult. Ragged proximal step fracture. |
| C-757 | A lS2W Baulk | *Bison bison* | Right radius, midshaft one-half, anterior face, bounded by spiral fractures. Local crescentic scars along broken edges and tooth-scoring. |
| C-758 | A lS2W Baulk | *Bison bison* | Femur shaft fragment, bounded by uneven spiral fractures. |
| C-759 | A lS2W Baulk | cf. *Bison bison* | Thoracic neural spine, shaft fragment, split longitudinally. Ragged fracture on one end. Light tooth-scoring. |
| C-760 | A lS2W Baulk | *Bison bison* | Right mid-series rib, shaft fragment. Uneven spiral fracture proximally. Freshly broken distally. |
| C-761 | A lS2W Baulk | *Bison bison* | Right posterior-series rib, shaft fragment from curvebelow tubercle. Split longitudinally. Ragged fracture proximally with tooth-punctures. Uneven spiral fracture distally. |
| C-762 | A 2S2W 10-20 cm B D #2 | *Bison bison* | Distal phalanx, complete. |
| C-763 | A 2S2W 10-20 cm B D #2 | ?*Bison bison* | Small fragment of cancellous bone, unidentifiable. |
| C-764 | A lS2W 20-30 cm | cf. *Canis* sp. | Fragment of zygomatic arch. Tooth-punctured. Ragged snap on one end; uneven spiral break on the other. |
| C-765 | A lS2W 20-30 cm | ?*Canis* sp. | Epiphysis from vertebral centrum, incomplete. |
| C-766 | A 2S2W 20-30 cm | *Bison bison* | Rib head, snapped from shaft above tubercle. Uneven. Spiral break with tooth-punctures. |
| C-767 | A 2S2W 20-30 cm | *Bison bison* | Distal sesamoid, complete. |
| C-768 | A 2S2W 20-30 cm | small mammal | Long bone shaft fragment, bounded by spiral fractures. |
| C-769 | A 2S2W 20-30 cm | *Bison bison* | Calcified costal cartilage, heavily chewed and tooth-punctured. |
| C-770 | Hearth #3 Sample | cf. *Bison bison* | Cranial fragment (frontal sinus strut). Edges snapped. |
| C-771 | A 2S2W 20-30 cm | *Bison bison* | Rib, juvenile, shaft fragment. Freshly broken proximally and distally. |
| C-772 | A 2S2W Baulk | unidentifiable mammal | Small fragment of cancellous bone, ?vertebral. |
| C-773 | A 0S2W 0-20 cm B sub D | *Canis* sp. | Neural arch of lumbar vertebra. Snapped from centrum. Spine snapped away. Fractures uneven to ragged. |
| C-774 | A 0S2W 0-20 cm B sub D | ?*Antilocapra americana* | Right calcaneum, articular end, very heavily chewed and eroded (partially digested) and barely recognizable. |

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| C-775 | A 0S2W | *Bison bison* | Right mid-series rib, proximal shaft fragment from curve just below tubercle. Ragged proximal fracture. Ragged distal fracture. |
| C-776 | A 0S2W | *Bison bison* | Pisiform carpal, complete. |
| C-777 | A 0S2W | small mammal | Lumbar pleurapophysis, snapped from arch. Both ends snapped. |
| C-778 | Hearth #1 172 cm | unidentifiable | Small flat bone fragment. Unidentifiable. Ragged snaps on edges. |
| C-779 | Hearth #1 172 cm | ?small mammal | ?small cranial fragment, with irregular snapped edges and tooth-punctures. |
| C-780 | Hearth #1 172 cm | ?small mammal | Cranial fragment, unidentifiable. |
| C-781 | A 0S0W | *Bison bison* | Fetal left ulna, incomplete. Light damage to olecranon and to distal end. |
| C-782 | A 0S0W 0-20 cm B sub D | cf. *Canis* sp. | Long bone shaft fragment, bounded by spiral fractures. Spalling of margins, and heavy scoring and tooth-puncturing of ends. |
| C-783 | A 0S2W 0-20 cm B sub D | *Bison bison* | Distal sesamoid, complete. Heavily chewed and eroded (partially digested). |
| C-784 | A 0S2W 0-20 cm B sub D | cf. *Bison bison* | Fetal neural arch of vertebra, left half, unfused. Tiny. |
| C-785 | A lS0W 15-30 cm B sub D | *Bison bison* | Distal phalanx, complete, juvenile. Scored and tooth-punctured proximally. |
| C-786 | A lS0W Hearth | *Bison bison* | Thoracic neural spine, distal half. Ragged fracture proximally. Distal end chewed to ragged margin with tooth-punctures, scoring, and splintering along margin of spine. |
| C-787 | Hearth #1 | *Bison bison* | Distal phalanx, complete except for minor fresh damage to tip. |
| C-789 | Hearth #1 | *Bison bison* | 2nd phalanx, complete. |
| C-790 | Hearth #1 | *Bison bison* | Proximal phalanx, immature, missing proximal epiphysis. Fits epiphysis C-793. |
| C-791 | Hearth #1 | *Bison bison* | Rib shaft fragment, split longitudinally. Ragged fracture at one end; fresh break at the other. Light tooth-puncturing. |
| C-792 | Hearth #1 | *Bison bison* | Right anterior-series rib, distal fragment. Freshly broken proximally. Distal end chewed to ragged margin, with tooth-punctures. |
| C-793 | Hearth #1 | *Bison bison* | Epiphysis of proximal phalanx. Fits C-790. |
| C-794 | Hearth #1 | *Bison bison* | Left ectocuneiform, complete. Articulates with C-714. |
| C-795 | Hearth #1 | *Bison bison* | Right metatarsal, juvenile, proximal half. Spiral fracture at midshaft with tongue extending up posterior face. Posterior half of articular surface chewed away; heavy tooth-scoring evident. |
| C-796 | A 0S1W 5 cm B D | cf. *Canis* sp. | Fragment of zygomatic arch, temporal process, spirally snapped at base. |
| C-797 | A 0S1W 5 cm B D | cf. *Canis* sp. | ?proximal shaft fragment of fibula, snapped at both ends. |
| C-798 | A 0S1W | *Bison bison* | Femur shaft fragment, bounded by uneven spiral fractures. Some broken edges show crescentic scars from chewing. Sixteen short transverse cut marks across proximal end of linea aspera. |
| C-799 | A 0S1W | *Bison bison* | Left mid-series rib shaft fragment, freshly broken at both ends. Fits C-800. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| C-800 | A 0S1W | *Bison bison* | Left mid-series rib, distal shaft fragment, fits C-799. Freshly broken proximally. Distal end chewed to ragged margin, with tooth-punctures. |
| C-801 | A 0S1W | *Bison bison* | Metatarsal shaft fragment, bounded by uneven spiral fractures. Heavily tooth-scored and punctured. |
| C-802 | A 0S1W | *Bison bison* | Femur shaft fragment, bounded by spiral fractures, Edges locally polished by scavenger-licking, |
| C-803 | A lS0W 15-30 cm | *Bison bison* | Distal sesamoid, complete. |
| C-804 | A lS0W 15-30 cm | *Bison bison* | Proximal sesamoid, complete. |
| C-805 | A lS0W 15-30 cm | *Bison bison* | Proximal sesamoid, complete. |
| C-806 | A lS0W 15-30 cm | small mammal | Occipital condyle, tiny fragment. Uneven spiral fractures. |
| C-807 | A lS0W 15-30 cm | cf. *Bison bison* | Small rib fragment. Ragged fractures, transverse and longitudinal. |
| C-808 | A lS0W 15-30 em | *Bison bison* | 1st tarsal, heavily chewed and eroded (partially digested). Side uncertain. |
| C-809 | A lS0W 15-30 cm | *Bison bison* | Calcified rib cartilage fragment. Fresh damage on edges. |
| C-810 | A lSlW Baulk | ungulate | Calcified rib cartilage, snapped. |
| C-811 | A lSlW Baulk | ungulate | Calcified rib cartilage, chewed. |
| C-812 | A 0S1W 15-25 cm B D #2 | *Bison bison* | Distal sesamoid, complete. |
| C-813 | A lSlW 15-30 cm | *Bison bison* | Proximal sesamoid, heavily eroded (partially digested). |
| C-814 | A lSlW 15-30 cm | *Bison bison* | $LI_1$, lightly worn. |
| C-815 | A 0S2W Baulk | cf. *Canis* sp. | Long bone shaft fragment, bounded by spiral fractures. Tooth-scored and spalled on broken edges. |
| C-816 | A 0S2W Baulk | cf. *Bison bison* | Tiny cranial fragment (sinus strut tissue). |
| C-818 | A 0S2W Baulk | cf. *Bison bison* | Tiny cranial fragment (sinus strut tissue). |
| C-819 | A 2S1W | small mammal | ?distal end of rib (or lumbar pleurapophysis), snapped proximally. |
| C-820 | A 2S1W | cf. *Bison bison* | Tiny cranial fragment (sinus strut tissue). |
| C-821 | A 0S0W | *Bison bison* | Distal sesamoid, complete, heavily eroded (partially digested). |

| | | | |
|---|---|---|---|
| C-822 | A 0S0W | cf. *Canis* sp. | Left zygomatic arch, temporal segment, snapped at base and at anterior end. |
| C-823 | A 0S2W<br>15-25 cm<br>B D #2 | *Bison bison* | Fragment of proximal articular surface, scooped and licked on cancellous surface. |
| C-824 | A 0S2W<br>15-25 cm<br>B D #2 | mammal | Small bone fragment, unidentifiable. Ragged broken margins. |
| C-825 | A 0S2W<br>15-25 cm<br>B D #2 | *Bison bison* | Fetal right ischium, nearly complete. |
| C-826 | A 0S2W<br>15-25 cm<br>B D #2 | cf. *Bison bison* | Tiny cranial fragment (sinus strut tissue). |
| C-827 | A 0S2W<br>15-25 cm<br>B D #2 | cf. *Canis* sp. | Incisor, heavily worn. |
| C-828 | A 0S1W<br>5 cm | *Canis* sp. | Caudal vertebra. |
| C-829 | A 0S1W<br>5 cm | *Canis* sp. | Caudal vertebra. |
| C-830 | A 0S2W<br>10-20 cm<br>B D #2 | cf. *Peromyscus* sp.<br>rodent, ground squirrel-sized | a. Left maxilla with $M^{1-2}$.<br>b. Vertebral arch, fragment. |
| | | cf. *Antilocapra americana* | Metacarpal, small proximal fragment. |
| | | *Bison bison* | a. Fetal frontal fragment.<br>b. Fetal vertebral centrum.<br>c. Fetal rib fragment.<br>d. 5 fetal bone fragments.<br>e. 2 fetal tooth fragments. |
| | | cf. *Canis* sp. | Small tooth cusp fragment. |
| | | mammal | 6 unidentifiable bone fragments (plus 3 stone flakes). |
| C-831 | A 0S1W<br>10-25 cm<br>B D #2 | *Canis* sp. | a. Right metacarpal V, proximal end, grooved and snapped for bead manufacture. One groove still remains on shaft.<br>b. Proximal phalanx, distal end, grooved and snapped for bead manufacture.<br>c. Left 4th metatarsal, distal end, grooved and snapped for bead manufacture. |
| | | small canid | a. Lateral metacarpal, distal end, grooved and snapped for bead manufacture.<br>b. Distal phalanx, complete.<br>c. 2nd phalanx, complete.<br>d. Proximal phalanx, complete.<br>e. 2nd phalanx, complete. Heavily eroded (partially digested). |
| | | *Canis* sp. | a. Three rib fragments, snapped.<br>b. Caudal vertebra. |
| | | cf. *Bufo* sp. | Astragalus-calcaneum. |
| | | *Bison bison* | a. Four fetal ribs and 3 rib fragments.<br>b. Right ulna, slightly damaged distally.<br>c. Metacarpal, unfused, complete; and tiny metapodial fragment.<br>d. Two vertebral arch segments.<br>e. Unerupted tooth fragment. |

| Number | Provenience | Taxon | Description |
|---|---|---|---|
| | | unidentifiable | 11 bone or tooth fragments. |
| C-832 | A 0S2W | *Lepus* sp. | Left calcaneum, eroded (partially digested). |
| | | small mammal | a. Rib fragment.<br>b. Fibula shaft fragment. |
| | | mouse-sized rodent | Cervical vertebra, immature. |
| | | bird, grouse-sized | Fragment of coracoid, too small for more precise identification. |
| | | unidentifiable | 22 bone and tooth fragments. |
| C-833 | A 0S2W<br>10-20 cm<br>B sub D | cf. *Erethizon dorsatum* | Fragment of lower incisor. |
| | | mouse-sized rodent, cf. *Peromyscus* sp. | a. Left premaxilla with incisor.<br>b. Right humerus. |
| | | rodent, size of ground squirrel | Atlas vertebra. |
| | | bird, size of sparrow | a. Atlas vertebra.<br>b. Tarsometatarsus. |
| C-834 | A 0S2W<br>10-20 cm | *Bison bison* | Fetal metacarpal, unfused, complete. |
| C-835 | A 0S2W<br>10-20 cm | unidentifiable | One bone fragment and one tooth fragment. |
| C-836 | A 0S2W<br>10-20 cm | *Bison bison* | a. Fetal supraoccipital, frontal fragment, basioccipital, and right premaxilla.<br>b. Fetal tooth fragments, unerupted, 7 in number.<br>c. Two fetal vertebral centra.<br>d. Three fetal thoracic neural spines.<br>e. 12 fetal vertebral neural arch segments.<br>f. 13 fetal ribs.<br>g. Two fetal sternebrae.<br>h Fetal right ischium, unfused.<br>i. Fetal left radius.<br>j. Fetal phalanx.<br>k. 5 fetal metapodials, unfused.<br>l. Fetal femur, right.<br>m. Fetal tibia, distal half. |
| C-837 | A 0S2W<br>10-20 cm<br>B sub D | *Canis* sp. | Caudal vertebra, complete. |
| C-838 | A 0S2W<br>10-20 cm<br>B sub D | *Canis* sp. | Caudal vertebra, complete. |
| C-839 | A 0S2W<br>10-20 cm<br>B sub D | *Canis* sp. | Caudal vertebra, complete. |
| C-840 | A 0S2W<br>10-20 cm<br>B sub D | *Canis* sp. | Caudal vertebra, complete. |

| | | | |
|---|---|---|---|
| C-841 | A 0S2W<br>10-20 cm<br>B sub D | *Canis* sp. | Caudal vertebra, complete. |
| C-842 | A 0S2W<br>10-20 cm<br>B sub D | *Canis* sp. | Caudal vertebra, complete. |
| C-843 | A 0S2W<br>10-20 cm<br>B sub D | *Canis* sp. | Caudal vertebra, complete. |
| C-844 | (collected spring 1976 with canid mandibles and skull) | *Canis* sp. | $LI_1$. |
| C-845 | (collected spring 1976 with canid mandibles and skull) | *Canis* sp. | $LI_1$. |
| C-846 | A 0S1W<br>15-25 cm | cf. *Bison bison* | Calcified costal cartilage, two fragments. |
| C-847 | slough | *Bison bison* | Left mandible, fragment of horizontal ramus with $LM_3$. Ventral half of ramus broken away, with smashing and crescentic scars evident on lateral face below $M_3$. $M_3$ in full wear, except for ectostylid. Light tooth-scoring. |
| C-848 | slough | *Bison bison* | Right mandible, horizontal ramus and base of ascending ramus, with $P_{3-4}$ and $M_{1-3}$. Freshly broken along ventral border. Ragged snap ahead of $P_3$. Ragged fracture along border of remaining ascending ramus (base). $P_4$ just erupting ($dP_4$ is probably still present, based on retention of freshly broken posterior root). $M_2$ freshly broken. $M_3$ erupting; second loph only partly exposed; hypoconulid still in socket. $M_3$ crown unworn. |
| C-849 | slough | *Bison bison* | Left mandible, horizontal ramus with $dP_{2-4}$ and $M_{1-2}$. Ventral border of ramus broken away; crescentic scars and cleaver blows on lateral face below $M_{1-2}$. $M_1$ shows flyaway metaconid. $M_1$ in full wear; $M_2$ erupted to level of $M_1$ and with very light wear on facets I-II. Ragged anterior snap at mid-diastema; ragged snap at mid-$M_3$ alveolus. $M_3$ not present, but alveolus shows it was more than two-thirds of final height. |
| C-850 | slough | *Bison bison* | Left mandible, anterior fragment from incisor sockets back to $dP_4$ alveolus. $dP_{2-3}$ present and $P_3$ in bud. $I_{1-2}$ unerupted in buds. Ragged snap at level of $dP_4$; ventral border below $dP_{2-3}$ snapped away. Single mental foramen. |
| C-851 | slough | *Bison bison* | $RM^1$, freshly broken. In full wear. |
| C-852 | slough | *Bison bison* | $LI_1$, complete, moderately worn. |
| C-853 | slough | *Bison bison* | $RI_2$, complete, moderately worn. |
| C-854 | slough | *Bison bison* | Right maxilla, fragment, with $P^{3-4}$ and $M^1$, all in full wear. Snapped dorsally at level of roots. Snapped along palatal border. |
| C-855 | slough | *Bison bison* | $RM^3$, nearly complete, unworn, but lightly polished on anterior loph. |
| C-856 | slough | *Bison bison* | $RP^2$, in full wear, and small fragment of maxilla. |
| C-857 | slough | *Bison bison* | Left maxilla, fragment, with $M^{2-3}$. Maxilla snapped dorsally at level of roots; and snapped along palatal border. $M^2$ in full wear. $M^3$ worn on facets I-II, III-IV, and V-VI, lightly; no wear on VII-VIII. |
| C-858 | slough | *Canis* sp. | Left premaxilla and maxilla fragment, with $LI^{1-3}$ and $LP^{1-2}$. Snapped dorsally above tooth roots; snapped across $LP^3$ alveolus. Fresh break on palatal border. |

# Stark Bison Kills & Occupation of Plateau Country

*Leslie B. Davis, John W. Fisher, Jr., Helen C. Strickland, Stephen A. Aaberg, Ann M. Johnson, and Robert J. Ottersberg*

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# Introduction

*Leslie B. Davis*

Kenneth J. Feyhl of Billings sent Davis on September 4, 1972 a memorandum entitled "Stark Bison Kill - 24ML564" that documented the history and status of a heavily vandalized archaeological site in south-central Montana. That memo is cited in full below (the attached site map appears herein as Figure 1) as background for the fieldwork and research that were inspired:

*This archaeological site is located in the SW1/4 of Sec. 29, T9N, R23E, Musselshell County, Montana. It was named the Stark Bison Kill by Stuart W. Conner [of Billings, Montana] who formally reported it in 1976 under site number 24 GV 407. Conner first learned of the site from J. A. (Dell) Stark of Roundup, Montana and surveyed it with Stark in 1958. The site is well known locally as a collecting area, having been potted on and off for many years. Conner told me the site had been potted the first time he saw it. I first saw the site September 8, 1972 in company with S. W. Conner, F. A. Wierzbinski and John C. Rogers. On that date we conducted a critical visual examination of the immediate site area and I prepared the sketch map attached hereto* [Figure 1].

*The site occurs about a mile northwest of the Stark family ranch buildings in an east-west trending draw. The draw is incised thru flat-lying sandstone lands which form terrace-like upland surfaces north and south of the site. A live spring issuing from the drainage bottom at the site maintains a trickle of water down the draw (even in September) flowing eastward approximately three miles where it empties into Pole Creek. At the site the draw is more narrow than it is both to the east and to the west. Eastward*

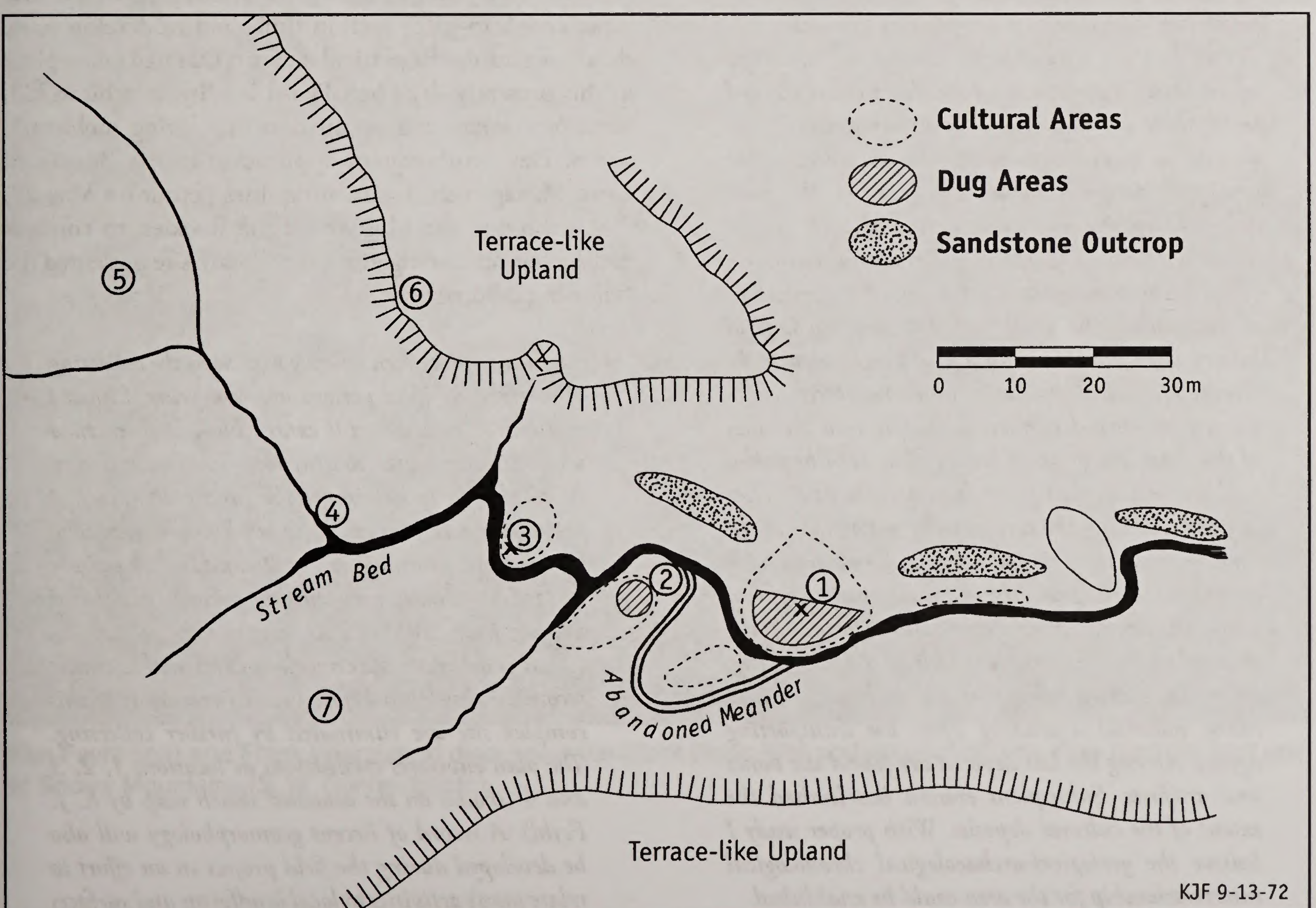



**Figure 1.** K. J. Feyhl's 1972 sketch map of the Stark Bison Kills Site.

*the draw opens into a wide, broken plain (Pole Creek Valley) and to the west it opens up into a small (half-mile wide) erosional basin. As shown on the attached sketch map the cultural deposits occur in the narrow part of the draw in small isolated areas on both the north and south banks of the stream bed. They are exposed both in naturally eroded cut banks and in two areas where collectors have dug into them. The deposits contain abundant bone along with stone artifacts, waste flakes, and at station No. 2 on the sketch map, some dark gray potsherds.*

*The only artifacts collected from the site by our survey of September 3 were found on the surface and consist of the distal tip of a small projectile point from the tailings left by collectors at station No. 1, thirteen potsherds from No. 2, and a bifacially flaked edge fragment of a knife or projectile point at No. 3. A very small knife of pinkish gray chert, bifacially flaked on all edges, 1-3/8" long and 9/16" wide was found on the surface at station No. 5, not associated with the deposits described in the narrow portion of the draw. Flakes, fire reddened stones, and cut and burnt bone were noted at No. 6 and 7, neither station associated with the deposits in the draw.*

*I believe the site is worthy of scientific excavation. Though it has been dug in two places I think there are sufficient deposits remaining, some untouched, to put together the human as well as the geological history of the site. I believe that the small cultural deposits remaining here and there in the draw, fortuitously spared in the erosional meanders of the streambed, contain the necessary information to reconstruct the geological and anthropological history with a very minimum of overburden to be removed (an ideal situation). In several places, where the stream meanders have cut deeply into the sides of the draw, the original bedrock has been breached and the resulting cut bank faces become valley cross sections revealing the succession of geological events. One sees that the original bedrock formations were eroded into a channel. The channel was then refilled with sediments. At the sides and bottom of the channel one sees the coarse rubble of the first filling, later and shallower deposits are of both fine and coarse material depending upon the transporting agency. Among the last deposits are found the bones and artifacts. Subsequent erosion has limited the extent of the cultural deposits. With proper study I believe the geological-archaeological chronological interrelationship for the area could be established.*

*The artifacts described above and several photographs of the site are in my possession. Other photographs were taken and are in the possession of S. W. Conner, F. A. Wierzbinski and John C. Rogers (Feyhl, pers. comm.).*

Davis visited the site thereafter in March 1973 in company with Feyhl, Conner, Stark, Rogers, and Wierzbinski from Billings. Collectors had been despoiling the remaining deposits shortly before they arrived; potsherds and a few flaked stone artifacts, including an arrow point, were recovered from the fairly fresh backdirt.

Cramer (1987) locates the site in the N1/2 SW1/4 SE1/4 SW1/4 of Section 29 by reference to the Timber Buttes Quadrangle: "The east edge of the high tableland called Timber Buttes lies just .5 m west of the site." See Taylor (1988) for the UM site report.

Although the site and its several prehistoric cultural deposits was repeatedly vandalized over the years, the 1973 spring survey party felt none the less that selective excavation might still yield an informative record of surviving cultural materials. It would be possible to at least establish physical stratigraphy, identify the archaeological cultures represented, to place each in time, and to develop some details regarding the particular events that had taken place at this presently dry High Plains locality, as a bison kill, meat-processing, and occupation site during prehistoric times. Davis' subsequent application to the Bureau of Land Management for an antiquities permit on May 23, 1973, through the Museum of the Rockies, to conduct archaeological investigations at the Stark site presented the following rationale:

> *The site has been severely wasted by the collecting of artifacts by local persons over the years. Limited cultural deposits are still extant but are threatened with discovery and destruction. Excavations will be conducted to determine the precise character of prehistoric activities conducted by bison hunters who utilized this drainage as a kill-campsite. A cursory surface examination revealed the presence of deposits ranging from 5000 to 200 years in age.*
>
> *It is desirable that a well-documented scientific record be developed before the last remnants of this complex site are eliminated by further collecting. The plan envisages excavations at locations 1, 2, 3 and 4 (shown on the attached sketch map by K. J. Feyhl). A record of Recent geomorphology will also be developed during the field project in an effort to relate man's activities to local landforms and surfaces*

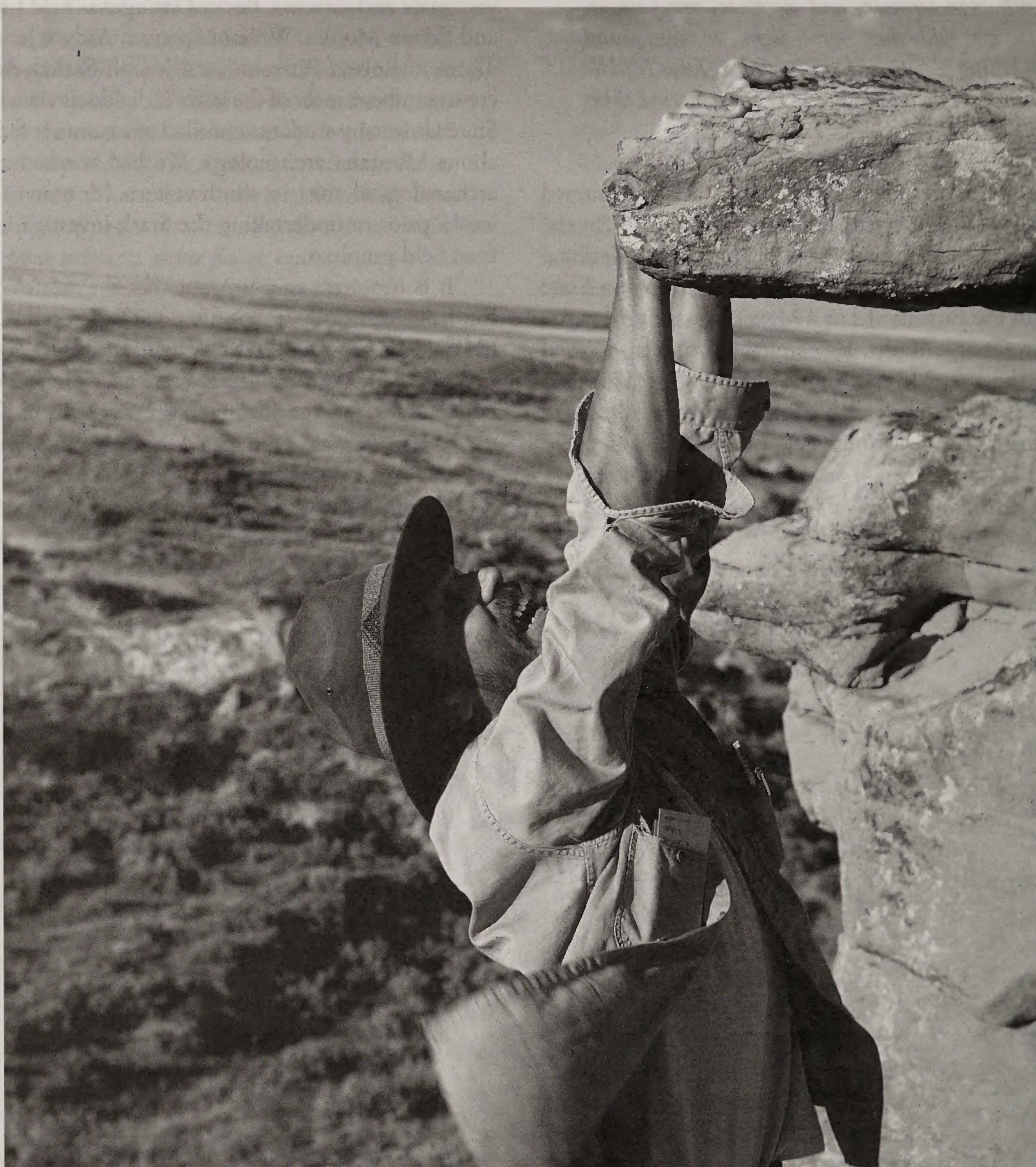
*in the valley bottom. Datable obsidian is present in both non-ceramic and ceramic occupations. Excavation will shed some light on communal bison killing practices during Mid-to Late Middle Prehistoric Period and Late Prehistoric Period times (Davis 1973).*

An antiquity permit (73-MT-071) was later obtained by Montana State University on September 6, 1973, by the Division of Archaeology and Anthropology of the National Park Service, following approval by the Montana State Director of the Bureau of Land Management on May 31, 1973. Mr. George Raths, lessee of the property, allowed access to the site. Mr. Del Stark, the crew's genial host, made the Stark Ranch available as shelter during the 2-wk project, from July 31 through August 14, 1973.

The field crew consisted of Les Davis as principal investigator and director; Becky Dasinger as field supervisor; and Edwin Mohler, William Spencer, Ardyce Jensen, Jean Thorsen, Robert Peterson, and Joseph Shutak as student crew members; most of the latter individuals were Montana State University students enrolled in a summer field course about Montana archaeology. We had worked at several archaeological sites in southwestern Montana for seven weeks prior to undertaking the Stark investigation as the final field problem.

It is necessary to point out that the name "Stark Bison Kills" can easily be confused with the Stark-Lewis site (24GV401) reported by Ken Feyhl (1972) in *Archaeology in Montana* 13(2). Accordingly, reference to the "Stark site" hereinafter refers specifically to the Stark Bison Kills.

Ken Feyhl (left) and Frank Wierzbinski discussing the Stark Bison Kills and occupation site, view north to east end of Snowy Mountains (S. W. Conner photo).



Ed Mohler finds himself in a dire predicament while exploring the cliff face (Robert Peterson photo).

# The Natural Setting

*Robert J. Ottersberg*

## Location

Bison were killed on multiple occasions during prehistoric times at the Stark site 26 km west-northwest of Roundup along Golf Course Road in Musselshell County, south-central Montana (Figure 2).

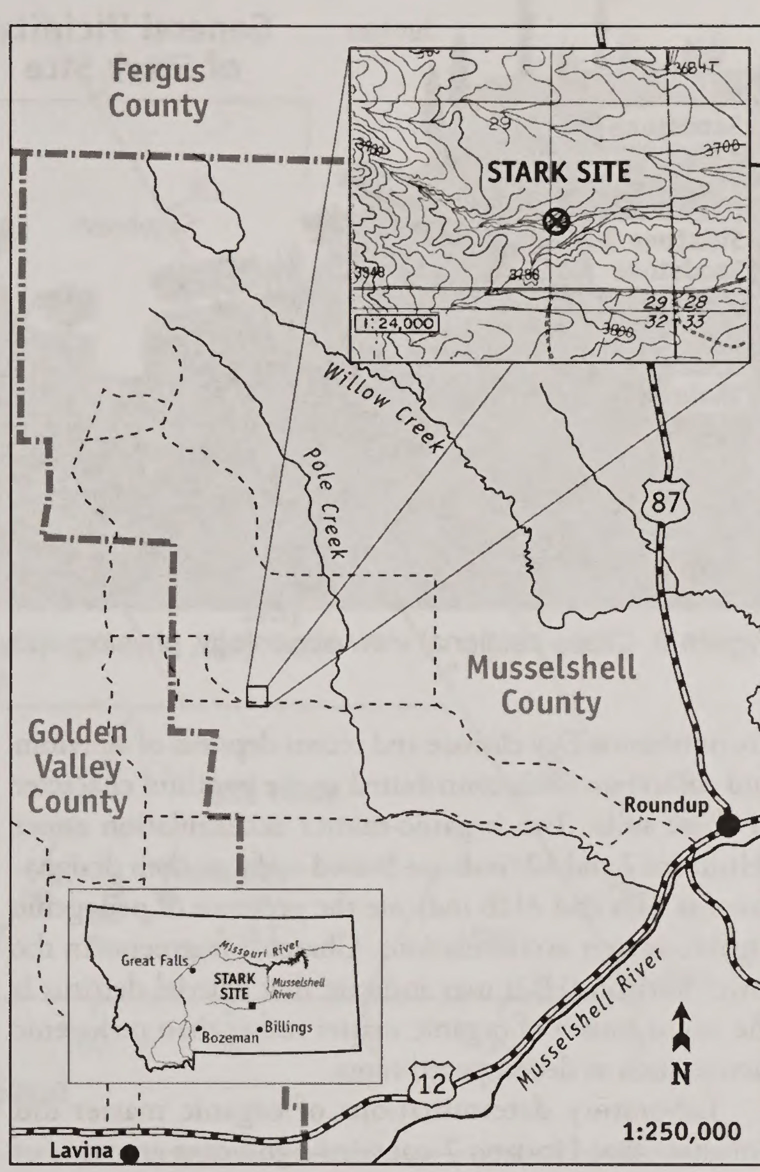


Figure 2. Location of the Stark site in south-central Montana.

## Geology

Bedrock at the Stark site consists of interbedded tan and gray sandstone and buff to gray shale of the Late Cretaceous-age Lance Formation (Zimmerman 1956). Tertiary-age formations that remain intact to the southeast had been eroded from the site area and replaced by a cap of Quaternary terrace deposits which is present as gravels .8 km west of the site. Site elevation is 1,110 m a.m.s.l.

## Topography

The Stark bison kills, and subsequent meat-processing and residential activities, took place at or in the vicinity of an intermittent stream channel that flows east into Pole Creek. North of the site are smooth to gently rolling plains, while to the west and south are rolling to steeply sloping, strongly dissected slopes that lead to narrow remnants of a flat-topped Quaternary-age terrace. The banks of the stream channel are about 6 m high to the north and they rise 1 to 15 m to the south (Figure 3).

## Climate

Mean annual precipitation in this semi-arid site setting is 4 to 5 cm, most of which comes as rain during summer thundershowers that can provoke significant erosion. Mean winter air temperature is 12.5° C, with a mean summer air temperature of 31° C (U. S. Department of Commerce 1960).

## Vegetation

Big sagebrush, skunkbush, rabbitbrush, bluebunch wheatgrass, and western wheatgrass predominate in the immediate site vicinity. Shortgrasses and scattered shrubs dominate the plains to the north, while Ponderosa pine, juniper, and scattered shrubs and grass are common on rocky outcrops of hills to the south and west.

## Soils

Sediment samples were collected from the cutbank wall adjacent to the excavated east wall of the arroyo of Excavation Area B (Figure 7) for soils analysis. The major soil horizons and distinctive sediments were sampled and analyzed. Appendix 1 identifies the morphological characteristics of each of those 13 samples, while Appendix 2 presents detailed results of chemical analysis by the hydrometer method (sand, silt, clay), total organic matter (OM), calcium carbonate ($CaCO_3$) equivalent, and extractable phosphorus (P).

Soils at the site are weakly developed. Based on morphology, they are classified as a fine loamy family of Typic

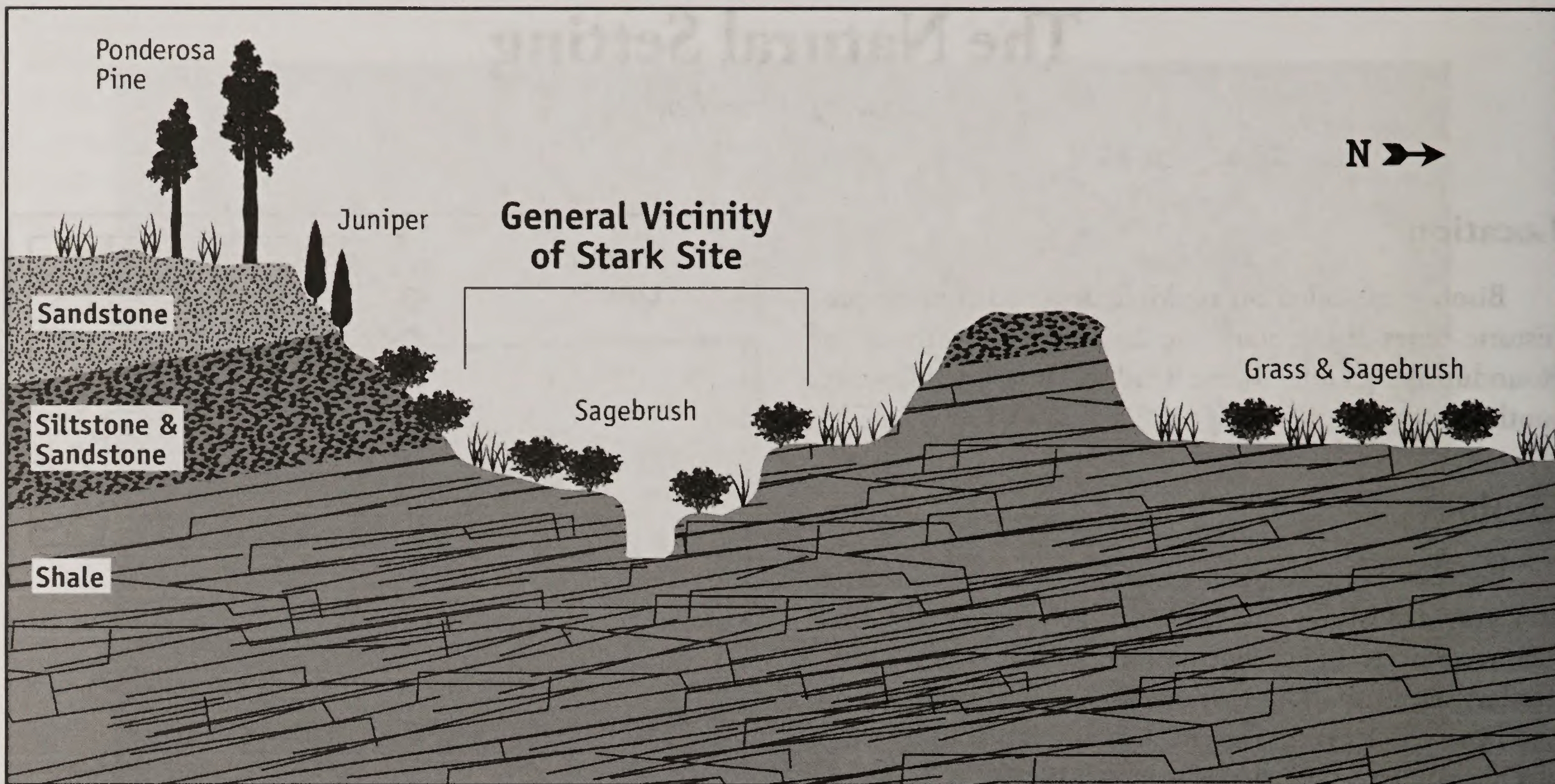



**Figure 3.** Cross-sectional view of geology, physiography, and vegetation in the Stark site vicinity.

Torriorthents. Dry climate and recent deposits of alluvium and colluvium both contributed to the youthful character of these soils. Two organic-matter accumulation zones (Horizons 7 and 12) indicate buried surfaces: their designations as Allb and Al2b indicate the presence of pedogenic organic-matter accumulations. Charcoal fragments in the lower horizon (Hl2) may indicate that alluvial detritus is the major source of organic matter rather than pedogenic factors such as decomposed roots.

Laboratory determinations of organic matter did not show that Horizon 7 contains significant amounts of organic matter (Figure 4). However, Horizon 12 has high organic matter content. The organic matter peak in Horizon 2 is larger than that of either Horizon 1 or 7, indicating that stability of the Horizon 2 surface was probably greater than for any other. It is now being buried by cultural debris such as that in which it had formed originally.

Two distinctive P peaks present in Horizons 5 and 11 (Figure 4) are not associated with pedogenic organic matter or any significant organic peak. Human contributions of P during those intervals may possibly explain these P peaks.

Two major sources of sediment are suggested from the texture of sediments (Figures 5 and 6). Heavy loam textures in Horizons 1-3, 9-10, and 12-13 may be derived from local colluvium or alluvium. Silt loam textures in Horizons 8 and 11 may be eolian or possibly alluvial, but

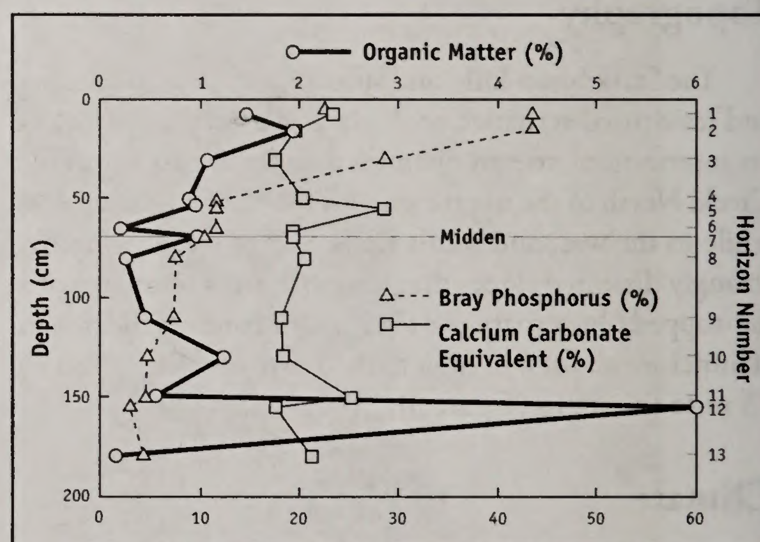



**Figure 4.** Geochemistry of Area B sediments.

are probably not colluvial in origin. High silt and low clay fractions distinguish these horizons from other sediments in the profile (Figures 3 and 4).

High $CaCO_3$ content and position suggest a colluvial origin for parent materials in Horizons 1-3. All other horizons have significantly lower $CaCO_3$ content (Figure 4). Alluvial deposits were probably the major contributor to both horizons below Horizon 3 since an eolian source for the silt loams (Horizons 58 and 11) should have higher $CaCO_3$ levels.

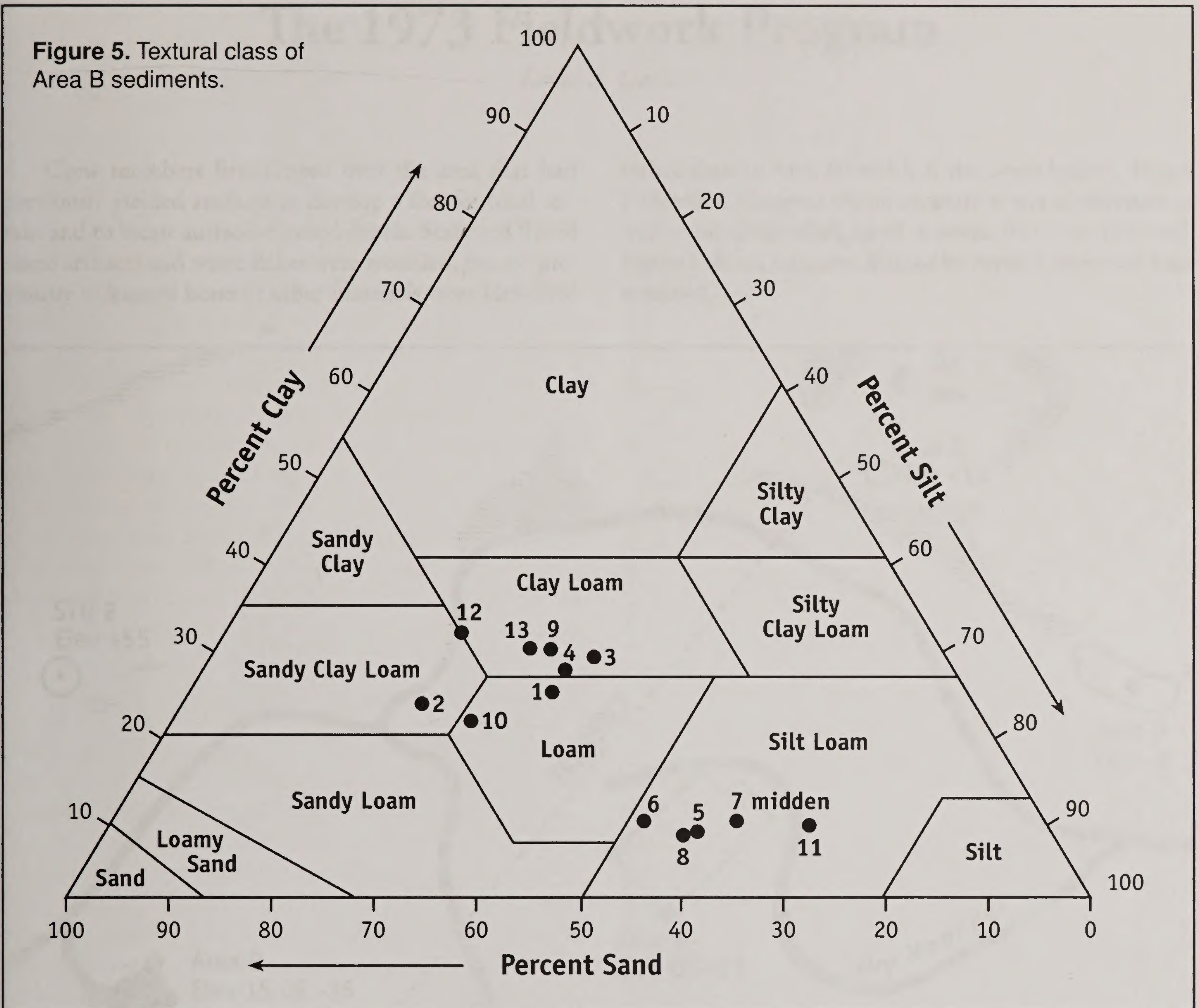



Figure 5. Textural class of Area B sediments.

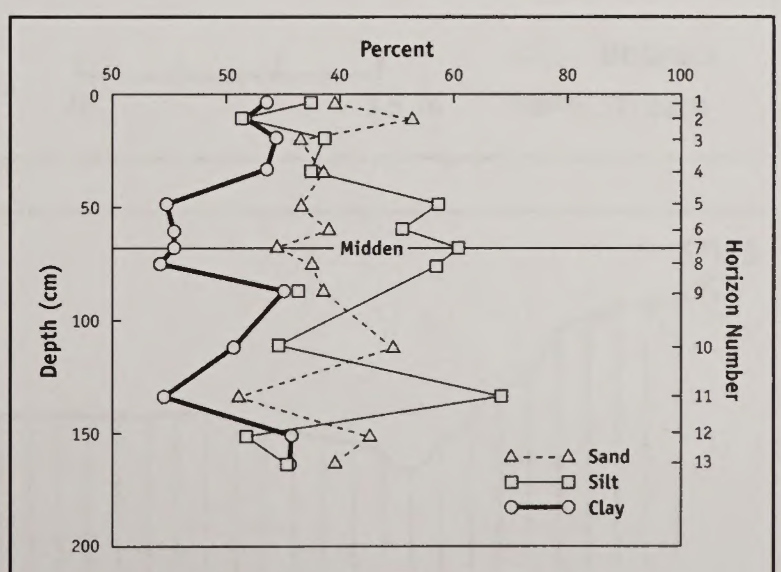



Figure 6. Particle size distribution of Area B sediments.

## Discussion

The midden (Horizon 7) has abnormally low organic matter and P (phosphorous) for a layer that contains as much bone as was recovered by excavation. Bone fragments noted in Horizon 8 may have actually been derived from bone fragments in Horizon 7. Nor was P significantly abundant in Horizon 8. Calcium carbonate content is sufficiently high to prevent loss of P to leaching, and the site deposit is not sufficiently old to have P bound in an unextractable form. Small sample volume and collection made outside the Area B excavation unit proper may indicate that the sediment sample analyzed inadequately represents the organic content of the midden itself.

# The 1973 Fieldwork Program

*Leslie B. Davis*

Crew members first ranged over the area that had previously yielded artifacts to develop a feel for local terrain and to locate surface-exposed debris. Scattered flaked stone artifacts and waste flakes were recorded, but no previously unknown bone or other materials were identified (other than in Area B, which is discussed below). Figure 7 identifies the areas where excavation was undertaken as well as otherwise-designated deposits that were surveyed. Figure 1 shows locations defined by Feyhl as they were later renamed.

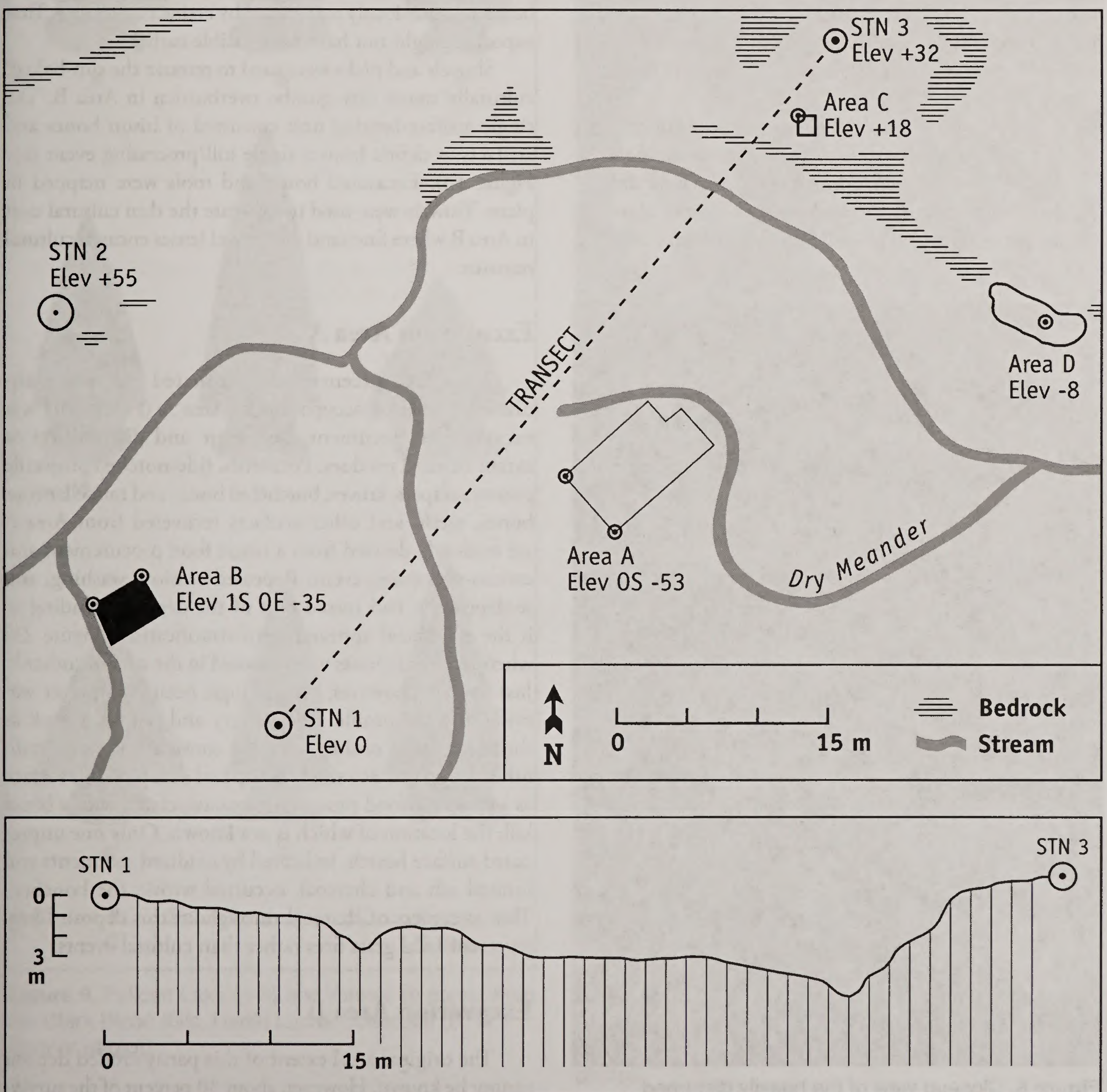



**Figure 7.** Base map (a) and a southwest-northeast transect (b) across the site and drainage.

Tailings at Feyhl cultural station No. 1 (Figure 1) that were re-screened with .25-inch mesh yielded fragments of dart points. Testing revealed that this deposit, designated here as Area D (Figures 7 and 8), had been destroyed by collectors. Figure 9 shows projectile points from this location, photographed by Stuart Conner, that had been collected by Harlin Lucas of Harlowton, Montana, all but one of which (an obsidian Yonkee point, Figure 9i) are Pelican Lake in type. Joe Cramer(1991) visited the site (designated by him as site #MU-2) in company with Oscar Lewis in 1953, 1954, and 1957. Pelican Lake points were collected during those visits (Figure 10c, e, and h) as was a Yonkee point (Figure (10d). At that time, that deposit was still partly extant (J. Cramer 1986, pers. comm. to Davis).

> *....2-hole artifact made of steatite* [Figure 10i collected from Area A] *is definitely an arrowshaft [possibly a dart shaft] 'straightener.' The holes are quite round due to the push-pull action and there are traces of black pitch still in them. I imagine that when it was last used it was rather well gummed up. The holes are .28" in diameter. Its dimensions are .95" thick, 2.5 average length and 1.95" average width. (Note: both holes are drilled at about 10° from vertical) (J. L. Cramer, pers. comm. to L. B. Davis, 14 January 1987).*

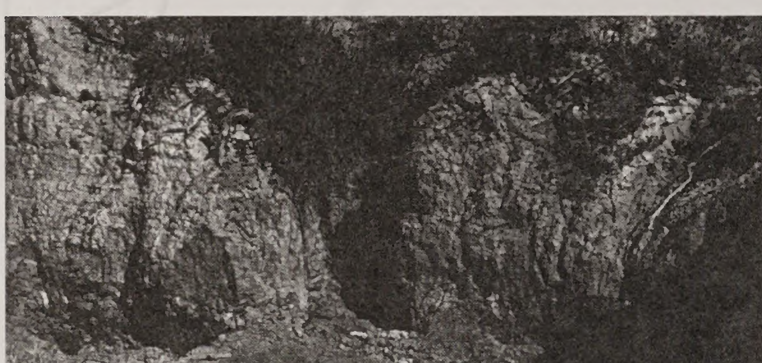


Figure 8. Closeup view of the heavily disturbed midden section in Area D.

A 2x2-m grid established farther upstream along the east edge of the arroyo above Area A is designated Area B (see Figures 7 and 10). Inspection of the cut bank revealed a thin, continuous stratum composed of processed bison bones not previously recognized by artifact collectors. That exposure might not have been visible earlier.

Shovels and picks were used to remove the sun-baked, culturally sterile clay gumbo overburden in Area B. The single artifact-bearing unit consisted of bison bones and artifacts as debris from a single kill/processing event (see Figure 13). Excavated bones and tools were mapped in place. Trowels were used to excavate the thin cultural unit in Area B where fine sand and gravel lenses encased cultural remains.

## Excavation Area A

About 20 percent of the estimated remaining undisturbed area of occupation in Area A (Figure 10) was excavated to document the nature and distribution of extant cultural residues. Potsherds, side-notched projectile points, scrapers, knives, butchered bison, and miscellaneous bones, teeth, and other artifacts recovered from Area A are evidently derived from a single food procurement and carcass-processing event. Repeated erosion, washing, and re-deposition had mixed part of the deposits, lending to it the superficial appearance of stratification (Figure 23) where several deposits were exposed in the stream cutbank. Just upslope, however, only a single occupation layer was evident in the profile. The pottery and points, as well as the dated use of obsidian and the consistent use of certain lithics, suggest that a single group had occupied this surface as a camping/food processing area associated with a bison kill, the location of which is not known. Only one unprepared surface hearth, indicated by oxidized sediments and limited ash and charcoal, occurred within the bonebed. Thin streamers of charcoal throughout this deposit likely represent local grass fires rather than cultural events.

## Excavation Area B

The original areal extent of this partly eroded deposit cannot be known. However, about 30 percent of the surviving landform that contained this nearly horizontally laid

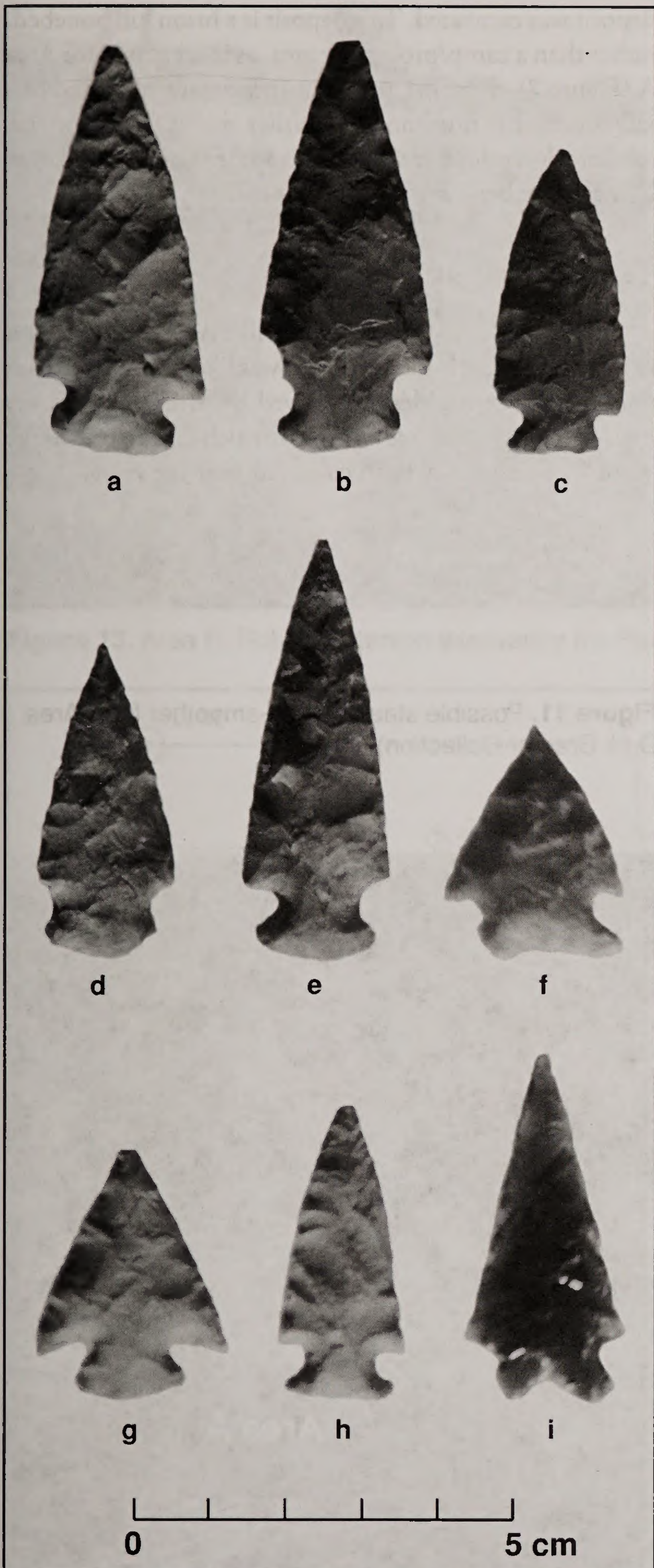



Figure 9. Pelican Lake (a-h) and Yonkee (i) points from the Stark Bison Kills, Harlin Lucas Collection (S. W. Conner photo).

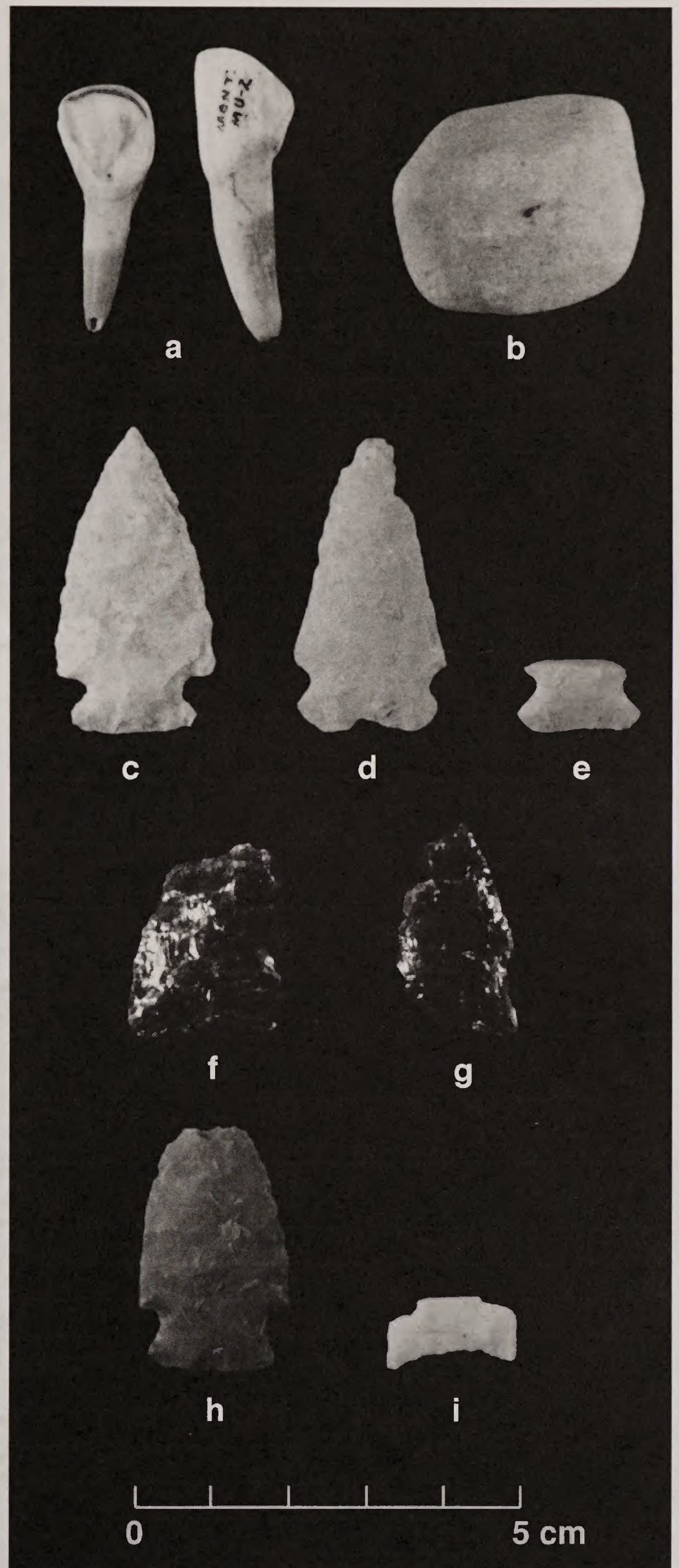
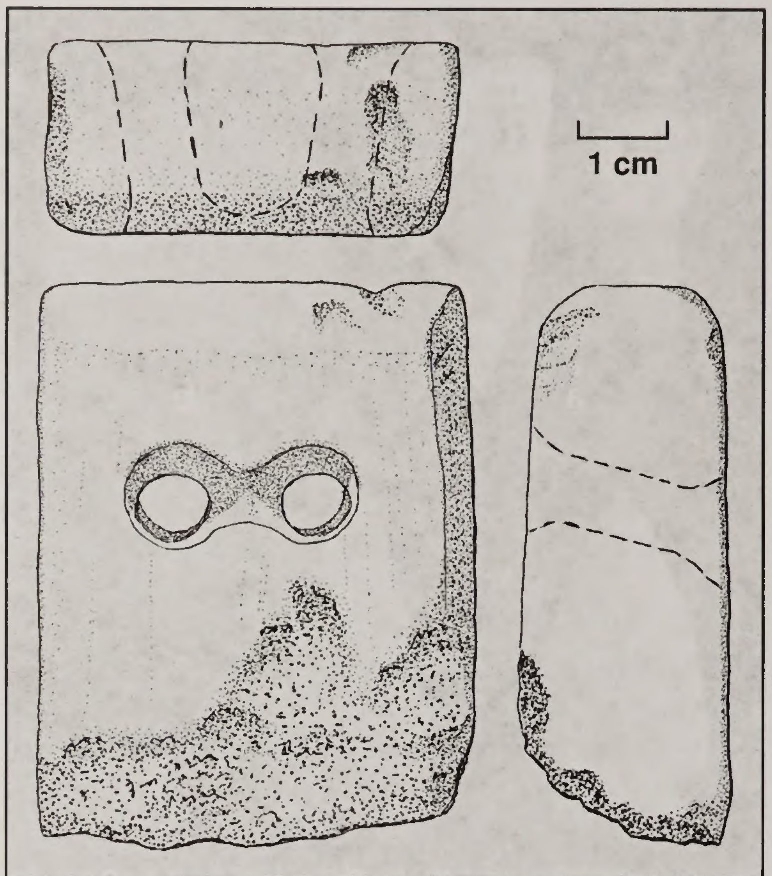



Figure 10. Artifacts recovered by Joe Cramer and Oscar Lewis during the 1950s (a-i) from Area D. However, the basal portion of a side-notched arrow point (i) was collected from Area A (J. C. Cramer photo).




deposit was excavated. This deposit is a bison kill bonebed, rather than a camp/processing area, as is suggested for Area A (Figure 7). Whether the camp/processing aspect of this kill is extant is not known. Neither the upslope nor immediate downslope areas nearby appeared promising. Area D may have been involved in this event.

## Test Areas C and D

Test Area C (Figure 7), which, like Area D, yielded no in situ evidence of buried artifacts, was likely associated with the bison bone middens destroyed by artifact collectors. Area D maybe the location from which "numerous large points" had allegedly been collected over the years.

**Figure 11.** Possible steatite shaft-smoother from Area D (J. Cramer Collection).


**Figure 12.** Locations of excavation Areas A and B relative to one another, the latter during excavation.

**Figure 13.** Area B, Robert Peterson excavating the Pelican Lake bison bonebed, looking southeast.

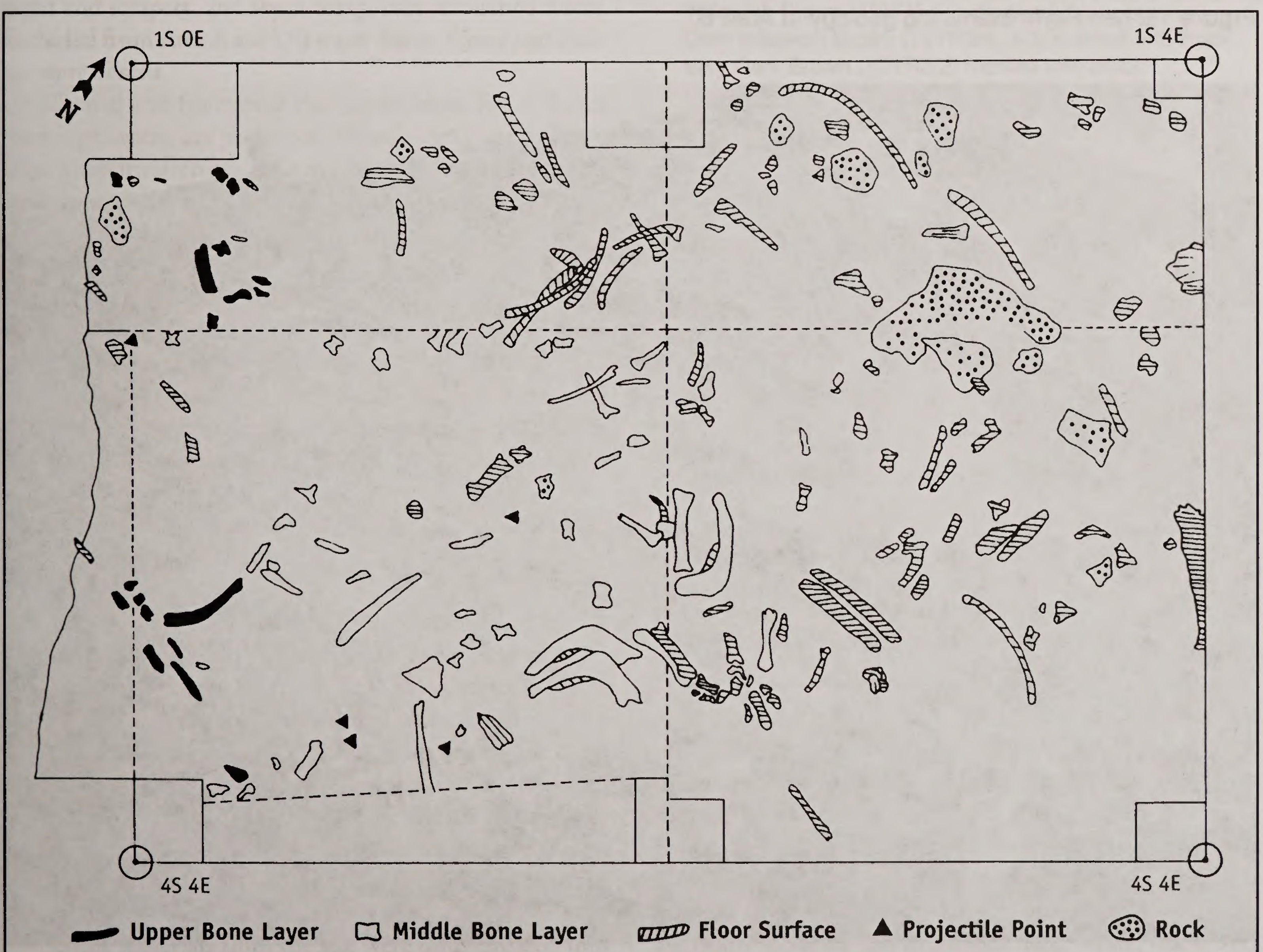



**Figure 14.** Plan view of Area B excavations showing differentiated upper and lower bison bones (prepared by Ed Mohler and Jeff Kaufmann).

**Figure 15.** Ken Feyhl examining geology at Area B.

**Figure 16.** Area A during excavation, looking west-southwest.

# Material Culture

*Stephen A. Aaberg, Leslie B. Davis, Ann M. Johnson, and John W. Fisher, Jr.*

Material culture remains from the Stark site include flaked, ground stone, bone, and shell artifacts and potsherds. Fifty-one complete and fragmentary flaked stone tools, one ground stone artifact, four bone and one shell artifact, and 210 potsherds comprise the artifact sample obtained by excavating Areas A and B (Figures 1 and 7).

## The Flaked Stone Artifact Assemblages

### Introduction

Only 24 projectile points, both complete and fragmentary, are typologically distinctive, while eight are not. The remaining flaked stone tools consist of four bifaces, eight end scrapers, and seven marginally retouched flakes. Included from Area A are 173 waste flakes. Cores and shatter were absent.

Formal and functional characterizations for all flaked stone specimens are presented. Descriptors include lithologic categorization based on macroscopic and microscopic examination. Munsell color codes were matched with all chert, chalcedony, siltstone, porcellanite, quartzite, silicified wood, and dacite specimens; some color varieties present in the lithic assemblages could not be characterized adequately using the Munsell charts for the northern latitudes; however, morphological and technological observations are also provided. Tools and flakes with edges sufficient for use-wear analysis were examined under a binocular microscope at 10.5 to 41.5X magnifications. Those data (Tables 1 through 5) are discussed below.

### Lithology

Seventy-nine color variations were distinguished among the Stark bison kill site lithics based on comparisons with the Munsell color codes. Five lithic color varieties could not be characterized on the Munsell chart because either the color was not represented in the charts or no one color dominated on polychrome specimens. The 84 recorded color varieties of lithics from Stark are neither geologically separate nor distinct lithologic varieties. Comparisons with Munsell system colors are intended only to standardize descriptions.

Lithic materials from the site were differentiated into eight geologically distinctive classes:

**Chert** (Table 1) is a compact, siliceous rock composed mainly of petrographically microscopic chalcedony and/or quartz particles (silica), irrespective of color or organic or

**Table 1.** Chert Varieties in the Lithic Assemblage.

**Red**
- Dusky Red (10R3/3)
- Weak Red (10R4/3, 4/4, 4/2; 2.5YR5/2) with white speckles; with very faint light mottling
- Purple (No Munsell)

**Brown**
- Dark Reddish Brown (2.5YR3/4) mottled with very dusky red
- Yellowish Brown (10YR5/4) with dendritic inclusions
- Dark Yellowish Brown (10YR3/4, 4/3) mottled with black
- Very Dark Brown (10YR2/2) mottled with black
- Light Yellowish Brown (10YR6/4) mottled with tans and browns and with dendritic inclusions
- Reddish Brown (2.5YR5/4)
- Pale Brown (10YR6/3)

**Gray**
- Gray (5Y5/1; 10YR5/1) with white inclusions
- Dark Reddish Gray (10R3/1)
- Dark Gray (5YR 4/1)
- Reddish Gray (10R5/1, with white inclusions)
- Light Gray (10YR7/1, 7/2) mottled with grayish brown
- Purplish Gray (No Munsell)

**White**
- White (2.5Y8/0) mottled with grayish blue

**Black**
- Black (10YR2/1) mottled with yellowish brown

**Polychrome**
- (No Dominant Color) mottled white, gray, and red

precipitated origin. Its structure ranges from cryptocrystalline to medium-grained. Genetically, jaspers and chalcedonies are very similar to chert. For purposes of this report, jaspers are recorded as chert, while chalcedony is separately classified. The predominant color variety and the largest number of cherts from the site are brown, although grays are nearly as varied and numerous. Red, white, black, and polychrome cherts are less frequent. Irregular mottling, speckling, and inclusions are common in many of the

cherts. Lusters range from dull to vitreous. Pot-lid fractures were rare. Evidence of thermal pretreatment were lacking.

**Chalcedony** (Table 2) is also composed of silicates and it has much the same genesis as chert. However, particles in cherts overlap and intertwine as the rock develops, whereas chalcedony develops as particles that loop together and do not overlap extensively. That development gives chalcedony its characteristic fibrous appearance and contributes to translucency. Chalcedony is the material of agate; therefore, specimens of agate are categorized with chalcedony. The most common colors for Stark chalcedonies are brown and gray, with a few translucent specimens. Mottling, banding, and inclusions are evident in some specimens.

**Table 2.** Chalcedony Varieties.

**Brown**
- Dark Reddish Brown (5YR3/2) mottled with black
- Reddish Brown (5YR4/3)
- Grayish Brown (10YR5/2)
- Yellowish Brown (10YR5/4)
- Dark Yellowish Brown (10YR4/4) with dendritic inclusions

**Gray**
- Dark Reddish Gray (5YR4/2) mottled with white
- Very Dark Gray (5YR3/1)
- Gray (5YR5/1) mottled with brown and white
- Light Gray (10YR7/1) mottled with grayish brown

**Translucent to Subtranslucent**
- Milky (No Munsell)
- Subtranslucent tinged with brown

**Siltstone** (Table 3) consists of generally fine-grained, consolidated clastic rock composed predominantly of silt-sized particles. Consolidation results from cementation by silica. A distinctive light gray siltstone, with more coarse dark and light quartz particles, predominates in the lithic assemblages.

**Table 3.** Siltstone Varieties.

**Gray**
- Light Gray (10YR7/2) fine grained with large quartz particles
- Dark Gray (5Y4/1)
- Gray (5Y5/1) mottled with light gray

**Brown**
- Very Pale Brown (10YR7/4)
- Pale Brown (10YR6/3)

**Quartzite** (Table 4) consists primarily of quartz particles which comprise a solid, opaque rock created by metamorphic alteration or by the cementation of sandstone by replacement of sediment with silica. This lithic displays considerable variability in color and granularity. Gray and brown quartzites appear in nearly equal percentages at Stark with rare red varieties.

**Table 4.** Quartzite, Dacite, Silicified Wood, and Obsidian Varieties.

**Gray**
- Gray (10YR6/1; 5Y6/1)
- Dark Gray (10YR4/1)
- Light Brownish Gray (10YR6/2)

**Brown**
- Brown (7.5YR5/20)
- Light Yellowish Brown (2.5Y6/4)
- Pale Brown (10YR6/3)

**Red**
- Weak Red (10R4/2, 4/4)

Dacite

**Gray**
- Very Dark Gray (7.5YR3/0)

Silicified Wood

**Gray**
- Light Brownish Gray Banded with Very Dark Gray (10YR6/2, 3/1)

**Dacite** (Table 4) very generally refers to any dark, fine-grained igneous rock. Specifically, it is an extrusive composed primarily of calcic plagioclase and pyroxene which may or may not contain olivine. Granularity varies from very fine grained to coarse grained. The most common color is black or very dark gray. Dacite from Stark is exclusively very dark gray and lacks olivine.

**Silicified Wood** (Table 4) was formed by the replacement of wood by silica in a manner such that preserved the original form of the replaced wood. The replacement material is often chalcedony or opal. The single specimen from the site is banded and appears as two shades of gray.

**Obsidian** (Table 4) Black obsidian is a volcanic glass that has a glassy luster and fractures conchoidally. Archaeological obsidians that were transported to this locality from Wyoming, Montana, or Idaho are rhyolitic in composition (see Davis et al. 1995). Stark obsidian is black and varies from opaque to translucent depending on the thickness of tools or waste flakes.

**Table 5.** Corner-Notched Bifaces/Projectile Points: Formal Attributes and Lithology.

| Fig. #18 | Specimen Number | Condition | Dimensions | | | | | | Lithic Material | Blade Shape | Base Shape | Basal Grinding |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TL | SL | BW | SW | NW | T | | | | |
| a | 40 | midsection--original | | | 15.0 | | | 3.2 | Gray porcellanite (7.5YR5/0) | triangular--convex edges | | |
| b | 37 | complete--original | 35.8 | 7.6 | 15.9 | 13.2 | 11.3 | 4.1 | Light gray siltstone with large quartz particles (10YR7/2) | triangular | convex | none |
| c | 23 | complete--reworked | 36.2 | 6.8 | 20.2 | 14.2 | 12.4 | 5.6 | Light brownish gray banded very dark gray silicified wood (10YR6/2) | triangular--convex edges | straight | none |
| d | 27 | base missing --reworked | | | 19.5 | | 13.6 | 6.9 | Light gray siltstone with larger quartz particles (10YR7/2) | triangular | | |
| e | 5 | complete--original | 59.8 | 8.1 | 21.6 | 15.8 | 12.9 | 6.3 | Light gray siltstone (10YR7/2) | triangular--convex edges | convex | none |
| f | 29 | complete-- original | 36.0 | 6.1 | 18.1 | 11.5 | 10.2 | 5.0 | Light gray siltstone with large quartz particles (10YR7/2) | triangular | straight | none |
| g | 30 | proximal half--original | | 6.7 | 25.8 | 17.1 | 13.6 | 4.3 | Light gray siltstone with large quartz particles (10YR7/2) | triangular | straight | slight |
| h | 21 | proximal half--reworked | | 6.9 | 18.1 | 12.7 | 10.2 | 5.2 | Light gray porcellanite (5Y7/1) | triangular | slightly convex | none |
| i | 2 | tip missing --reworked | | 10.0 | 20.7 | 14.6 | 10.6 | 5.6 | Light gray porcellanite (2.5Y6/0) | triangular | slightly convex | none |
| j | 6 | tip missing --original | | 8.3 | 27.0 | 12.3 | 15.3 | 6.1 | Light gray porcellanite (2.5Y7/0) | triangular--convex edges | straight | none |
| k | 1 | midsection--original | | | 20.5 | | 12.5 | 5.0 | Light gray porcellanite (2.5Y7/0) | triangular | | |
| l | 19 | complete--reworked | 35.5 | 9.1 | 21.0 | 15.4 | 12.6 | 5.4 | Light gray porcellanite (2.5Y7/0) | triangular--convex edges | slightly concave | none |
| ni* | 8 | complete--reworked | 31.2 | 6.9 | 18.7 | 14.5 | 12.7 | 4.8 | Dark reddish gray chalcedony mottled with white (5YR4/2) | triangular | slightly convex | yes |
| ni | 25 | base missing --original | | | 21.9 | | | 3.9 | Light gray porcellanite banded with darker gray (2.5Y7/0) | triangular--convex edge | slightly convex | none |
| ni | 7 | base--original | | | | 16.1 | 12.1 | | Dark reddish gray porcellanite (10R4/1) | | slightly convex | none |
| ni | 56 | base missing-original | - | - | - | - | - | - | Black obsidian | triangular | none | none |
| ni | 20 | midsection-original tip | - | - | - | - | - | - | Gray porcellanite | triangular | straight | none |
| ni | 34 | tip | - | - | - | - | - | - | Gray porcellanite | triangular | straight | none |
| ni | 38 | midsection-original | - | - | - | - | - | - | Gray porcellanite | triangular | straight | none |
| ni | -- | base missing | - | - | - | - | - | - | black obsidian (h) | triangular | straight | none |

*ni = not illustrated

## Lithic Artifacts

Formal and functional characteristics for all tools in the Stark site collection are reported below. Included are morphological attributes, indications of use wear, and lithologic class.

### Projectile Points

**Corner-Notched Bifaces/Projectile Points** (Figure 17, Tables 7 and 8). Most corner-notched projectile points in the Northwestern Plains Region are associated temporally with the late Late Middle Prehistoric period (ca. 1,400 B.C.-A.D. 400) (Mulloy 1958). Since the type was first described by Wettlaufer (1955), numerous occurrences of Pelican Lake corner-notched points have been recorded from myriad archaeological contexts throughout the Northern and Northwestern Plains and the Northern Rocky Mountains. Although reports demonstrate dimensional and morphological variability between and among point populations, all share the characteristically distinctive barbs or ears formed by compared diagonal corner-notching or corner-removal (cf. Reeves 1983). Not all corner-notched dart points are of Pelican Lake derivation, however.

The typologically classifiable corner-notched points from Stark vary substantially in dimension, but all are distinctively barbed or eared as a function of corner-notching. Flaking ranges from poor to very fine in quality of workmanship.

Of the 17 corner-notched points, 14 retain edges sufficient for use-wear analysis (Table 7). Two of the latter specimens also bear signs of heavy use as cutting implements. Nine do not, and three others were possibly used secondarily as knives. Six points are complete and four others are nearly complete.

The proportion of complete, sharp, corner-notched points from Stark relative to broken and reworked points is high. This fact may relate to use of Area B at the site as a meat-processing locus. Points lost or discarded in the midden would be more likely to preserve intact than tools and points found in a workshop or campsite area where broken tools may have been replaced and intentionally discarded.

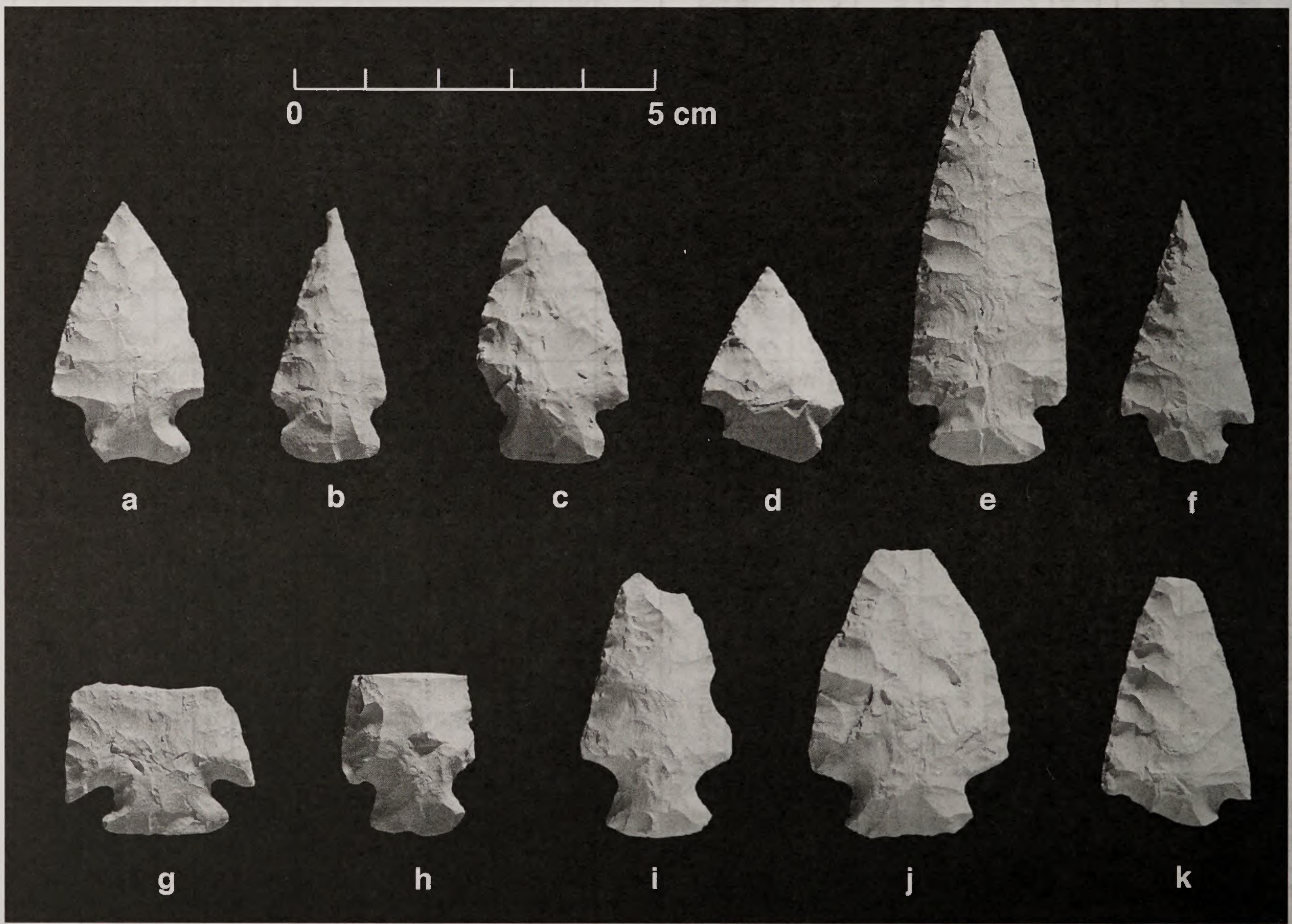



**Figure 17.** Pelican Lake projectile points from Area B (a-k).

**Side-Notched Bifaces/Projectile Points** (Figure 18, Tables 9 and 10). All side-notched projectile points from Stark are attributed to the late Late Prehistoric period. The archetype for these arrow points is a small, triangular biface formed by pressure-flaking, with narrow, but deep side notches placed well toward the tip from the base (Forbis 1962; Kehoe 1966, 1967, 1973; Reeves 1969). Bases are, with one straight-based exception, slightly concave. Flaking quality ranges from poor to good.

Two of the five side-notched specimens are complete, while a third lacks a tip. The remaining two fragments are basal portions. Three of these points retain edges sufficient for use-wear analysis. One reworked specimen (#24) bear signs of use as a cutting tool, as well as use as a projectile point (Table 9).

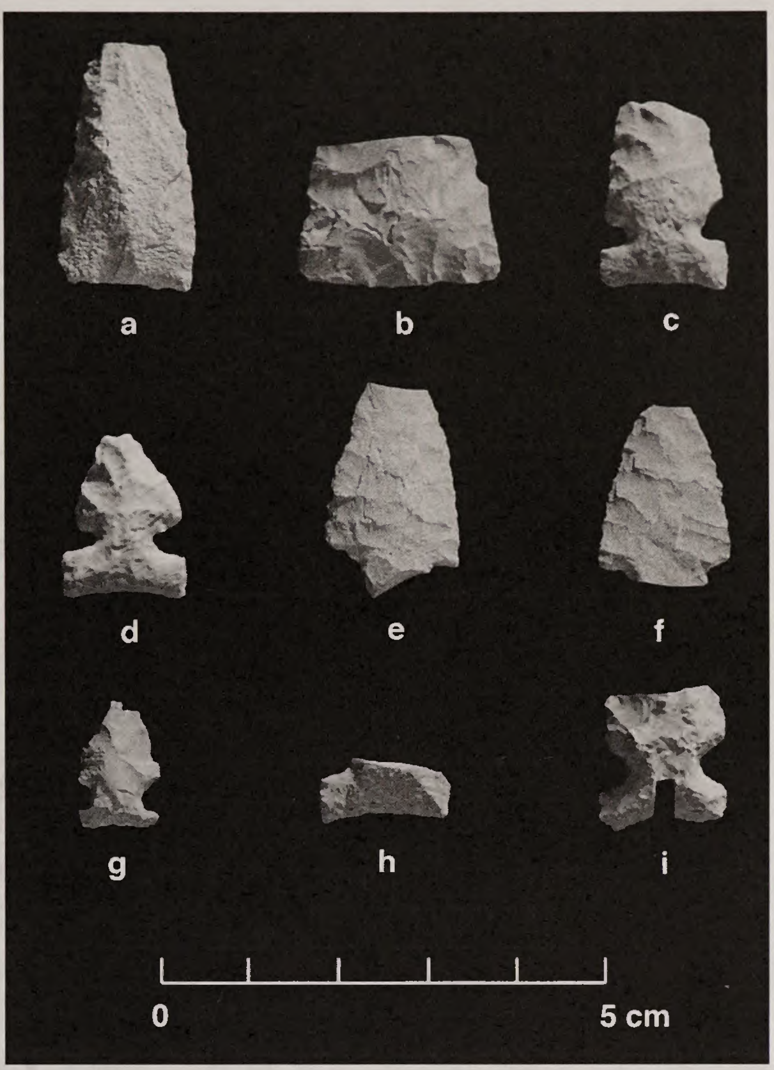



**Figure 18.** Side-notched projectile points from Area A (a-i).

**Unnotched Bifaces** (Table 10, Figure 19). Six fragmentary, bifacially worked, intentionally shaped bifaces are present in the assemblage. Four were fashioned from relatively thick flakes, while the other two had been formed on thin flakes.

Specimens 26, 47, 49, and 52 all bear signs of use as cutting tools: edges display step-fractures and crushed projections. Specimen 52, which has a corner-notched haft element, appears to have been resharpened several times. After the last resharpening, this biface had not been heavily used since only very light smoothing or crushing of projections were evident.

Specimens 16 and 22 do not exhibit wear indicative of use as cutting tools. Specimen 22 has crisp, clean edges, while 16 display some step fractures, but lack crushed and smoothed projections. These two artifacts are projectile point preforms or they may have served as points without notches. Triangular unnotched points are common in the archaeological record of the Northwestern Plains and they often co-occur with small side-notched points of the late Late Prehistoric period.

The other four bifaces are finished cutting implements. However, Specimen #47 lacks the fine finishing of the other three and, although only the tip is present, flaking had apparently been taken farther than on most of the bifacial preforms.

**Unifaces/End Scrapers** (Table 11, Figure 20). Eight end scrapers were recovered by excavation, six of them complete. All specimens display typical attributes of end scrapers: a distal working end with steep-angle, unifacial retouch they often extends around the entire tool margin, fashioned on a secondary reduction flake with a bulb of percussion (sometimes thinned) on the proximal end of a ventral surface that is concave or flat (except for Specimen #14). The end scrapers vary in size and shape (Table 11). All working edges are intact. Use-wear analysis of the steep-angled edge revealed crushed projections and extensive step fractures.

**Marginally Retouched Flakes** (Table 12). Seven edge-retouched flakes occur in the Stark assemblage. Four had been unifacially and one bifacially modified. Specimen #3 had been both bifacially and unifacially worked. Specimen 11 had been bifacially worked to form a graver.

All specimens display edge wear to varying degrees. Two had been fashioned on flakes that retain some cortex. One specimen had been formed from a large interior reduction flake.

## Debitage

Lithic debris resulting from the production of stone tools consists of 170 flakes, with cores or shatter present. All but one of the lithic types described earlier are represented in the detritus. Although one tool had been produced from silicified wood, no flakes of that material were recovered.

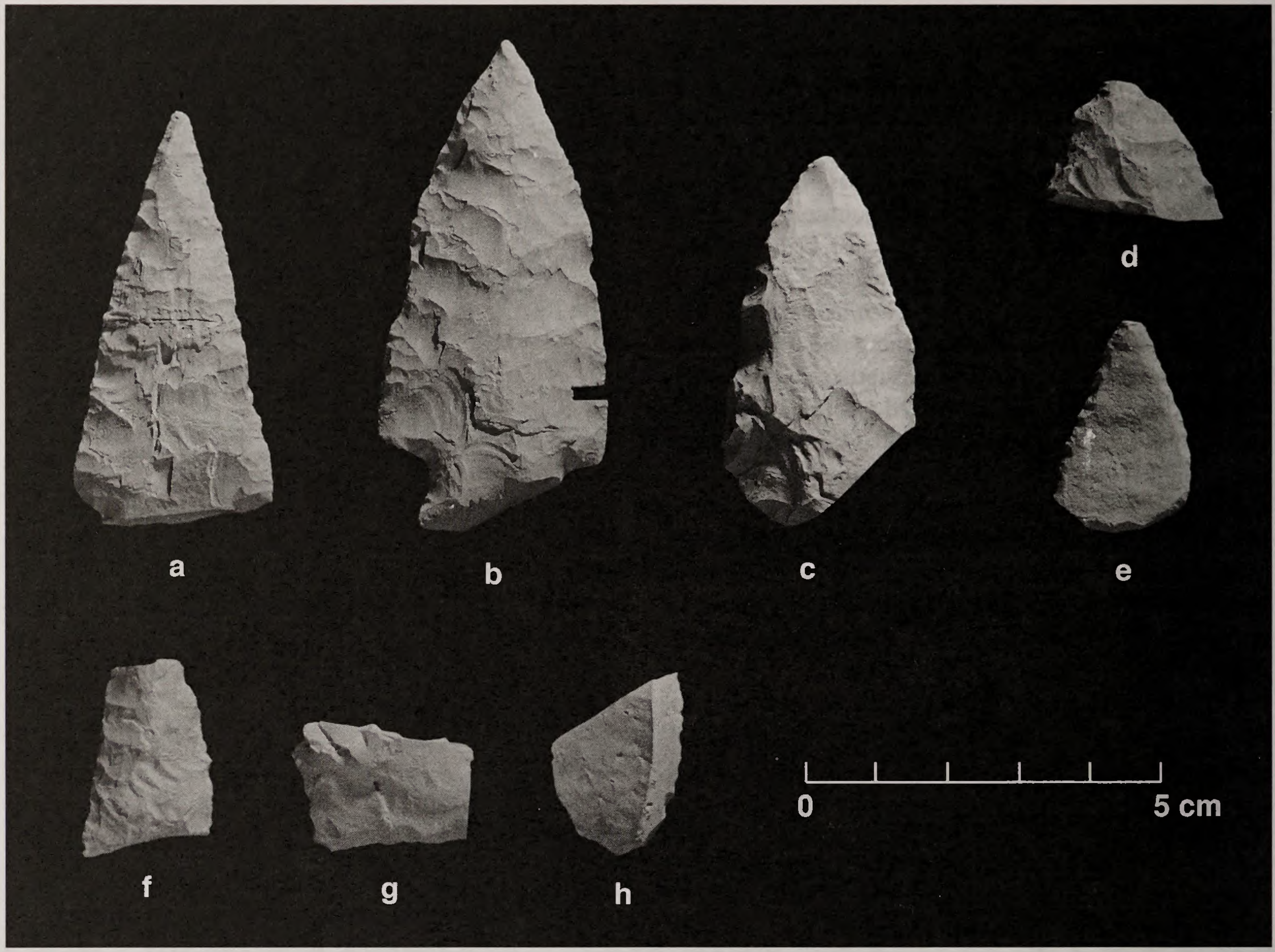



**Figure 19.** Unnotched bifaces (a-h).

Chert accounts for 32.4 percent of site debitage, with chalcedony 38.8 percent, light gray porcellanite 14.7 percent, quartzite 5.3 percent, obsidian 4.1 percent, dacite 3.5 percent, and siltstone 1.2 percent.

Flakes were categorized by reduction technique and stage of reduction by lithic material (Table 13). Definitions for flake classification follow Greiser (1983) and Frison (1968); the categories are finishing, thinning, and shaping flakes.

The first category (Group I) includes finishing and resharpening flakes generally less than 15 mm in length and width, less than 2 mm thick, formed by pressure-flaking. Twenty percent of the recovered debitage fell in this group.

Group II consists of thinning flakes produced by percussion flaking. These flakes have a minimum thickness of 2-3 mm and they tend to be longer and wider than flakes in Group I.

Group II flakes are products of the final reduction of lithic material to blanks and preforms and the thinning of these artifacts. The majority of site flakes (67.6%) are in this category.

The final category, Group III, consisted of flakes of variable size that resulted from percussion flaking that grossly reduced raw lithic material to blocks or nodules. Group III included primary and secondary reduction flakes and interior shaping flakes greater than 3 mm in thickness. Only 12.4 percent of all site flakes were classified in Group 3.

All lithic detritus from Stark was recovered from Area A, the late Late Prehistoric component. No debitage was found during testing of the Area B Pelican Lake component. The lack of debitage in Area B was expected since excavations defined Area B as a kill midden. A large fraction of the complete, sharp projectile points from the site were recovered from Area B.

Cultural remains from Area A include artifacts associated with processing game and with domestic campsite activities. Both broken and complete tools were recovered

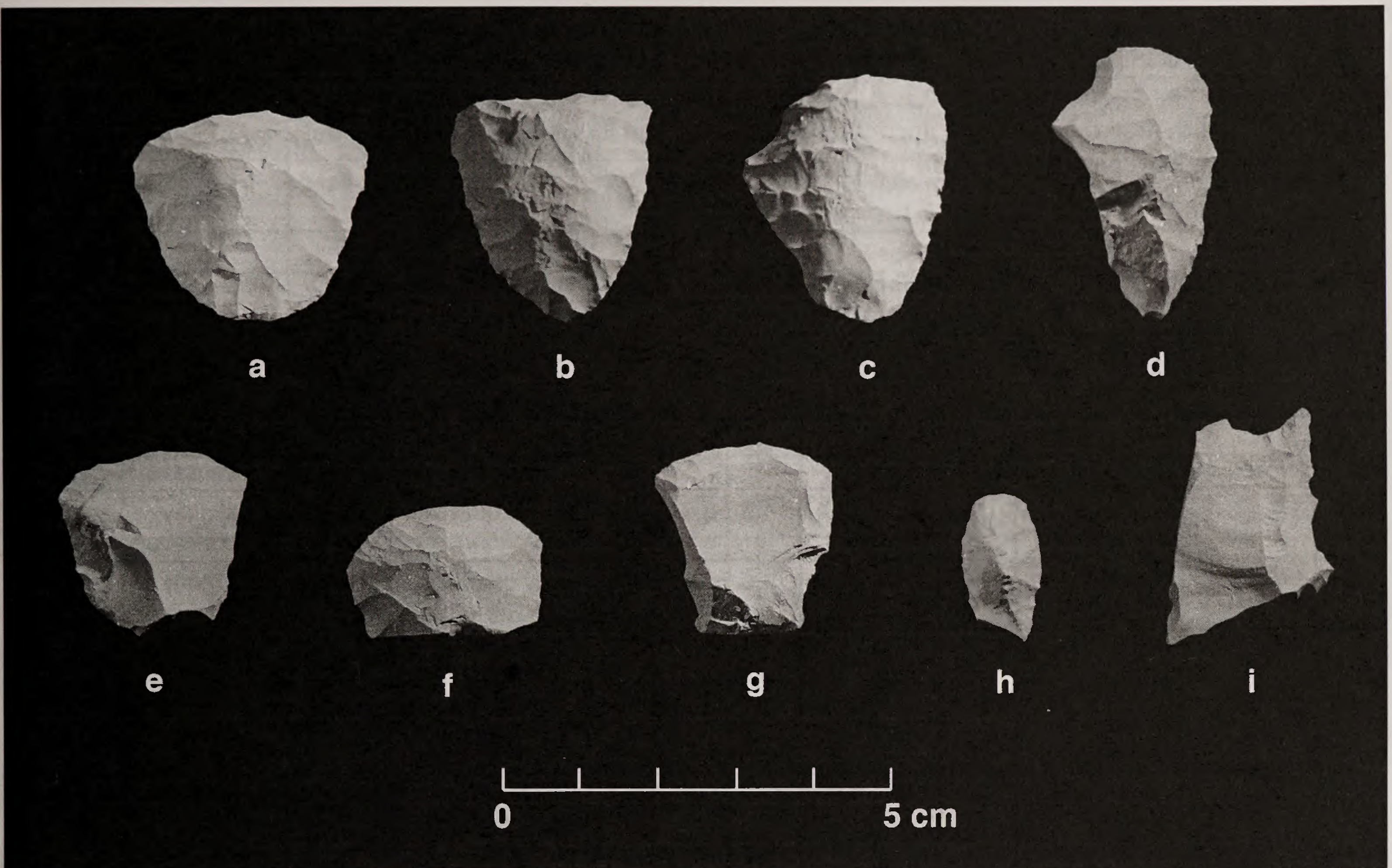



**Figure 20.** End scrapers and marginally retouched flakes from Area A (a-j).

**Table 6.** Corner-Notched Bifaces/Projectile Points: Functional Attributes.

| Fig. #18 | Specimen Number | Use Wear | Suggested Uses |
|---|---|---|---|
| a | 19 | None; crisp, clean edges | Projectile point |
| b | 37 | None; crisp, clean edges | Projectile point |
| c | 23 | Heavy polish, crushed projections and step-fractures | Projectile point/cutting tool |
| d | 27 | None; crisp, clean edges | Projectile point |
| e | 5 | None; crisp, clean edge | Projectile point |
| f | 29 | None; crisp, clean edges | Projectile point |
| i | 2 | Moderate polish, crushed projections and step-fractures | Projectile point/cutting tool |
| j | 6 | Some step-fracturing, otherwise crisp, clean edges | Projectile point/cutting tool |
| k | 1 | None; crisp, clean edges | Projectile point |
| ni* | 8 | Crushed projections and step-fractures | Projectile point/cutting tool |
| ni | 25 | Some crushed projections and step-fractures | Projectile point/cutting tool |
| ni | 40 | None; crisp, clean edges | Projectile point |

*ni = not illustrated

from Area A: points, cutting implements, scrapers, and ornaments. The debitage described above demonstrates that all stages of stone tool production had been carried out in Area A, although the primary reduction of raw material appears to have been a very small part of activities conducted there. The predominance of thinning flakes may be a result of recovery techniques or it may relate to use of that area of the site for a specific task such as producing blanks, preforms, and new tools.

**Table 7.** Side-Notched Bifaces/Projectile Points: Formal Characteristics and Lithology.

| Fig. 19 | Specimen Number | Condition | Dimensions | | | | | | Lithic Material | Blade Shape | Base Shape | Basal Grinding |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TL | SL | BW | SW | NW | T | | | | |
| a | 16 | | - | - | - | - | - | - | Maroon porcellanite | triangular | slightly concave | none |
| c | 17 | tip broken--original | | 6.9 | 13.4 | 14.5 | 8.5 | 3.2 | Brown quartzite (7.5YR5/2) | triangular | slightly concave | none |
| d | 24 | complete--reworked | 18.5 | 7.4 | 11.9 | 13.6 | 7.0 | 3.3 | Gray quartzite (10YR6/1) | triangular | slightly concave | none |
| e | | midsection-original | - | - | - | - | - | - | Gray porcellanite | triangular | none | none |
| f | 40 | midsection-original | - | - | - | - | - | - | Maroon porcellanite | triangular | none | none |
| g | 18 | complete--original | 14.4 | 5.3 | 9.9 | 8.6 | 5.8 | 2.7 | Weak red porcellanite (10R4/2) | triangular | straight | none |
| h | 48 | base--original | | | | 14.9 | | | Dark gray quartzite (10YR4/1) | | slightly concave | none |
| i | 55 | proximal half --original | | 8.9 | 13.5 | 14.2 | 8.1 | 4.1 | Black obsidian | triangular | slightly concave | none |
| ni* | 31 | midsection--original | 14.1 | | 8.9 | 2.2 | | | Dusky red chert (10R3/3) | triangular--convex edges | | |

*ni = not illustrated

**Table 8.** Side-Notched Bifaces/Projectile Points: Functional Characteristics.

| Fig. 19 | Specimen # | Use Wear | Suggested Uses |
|---|---|---|---|
| c | 17 | None; crisp, clean edges | Projectile point |
| d | 24 | Crushed projections and step-fracturing | Projectile point/cutting tool |
| g | 18 | None; crisp, clean edges | Projectile point |
| ni* | 4 | None; crisp, clean edges | Projectile point |
| ni | 31 | None; crisp, clean edges | Projectile point |

*ni = not illustrated

**Table 9.** Unnotched Bifaces: Lithology and Formal Characteristics.

| Fig.# 20 | Specimen Number | Condition | Dimensions | | | Lithic Material | Blade Shape |
|---|---|---|---|---|---|---|---|
| | | | L | W | T | | |
| a | 4 | base missing --original | | 27.6 | 5.3 | White mottled with grayish blue chert (2.5Y8/0) | triangular |
| b | 52 | base broken-reworked | -- | 31.5 | 7.3 | Black obsidian | convex |
| c | 26 | base fragmentary-reworked | 51.5 | 26.8 | 7.7 | Light gray siltstone with larger quartz particles (10YR7/2) | convex |
| d | 49 | distal tip-reworked | -- | -- | -- | Light gray siltstone with larger quartz particles (10YR7/2) | -- |
| e | 3 | | | | | | |
| f | 9 | | | | | | |
| g | 44 | | | | | | |
| h | 45 | | | | | | |
| ni* | 22 | proximal half-original | -- | 22.4 | 4.2 | Dusky red chert (10R3/3) | triangular |
| ni | 16 | distal end missing-original | -- | 15.2 | 4.4 | Weak red quartzite (10R4/2) | triangular |
| ni | 47 | distal tip-reworked | -- | -- | | Light gray porcellanite (2.5Y4/0) | irregular |

*ni = not illustrated

**Table 10.** End Scrapers: Formal Characteristics and Lithology.

| Fig. #21 | Specimen Number | Condition | Dimensions | | | Lithic Material | Blade Shape |
|---|---|---|---|---|---|---|---|
| | | | L | W | T | | |
| a | 28 | complete-original | 27.5 | 29.5 | 8.0 | Light yellowish brown chert mottled with tans and browns (10YR6/4) | sub-triangular |
| b | 35 | complete-original | 29.3 | 25.7 | 8.4 | Dark reddish brown chalcedony (5YR3/2) | sub-triangular |
| c | 15 | complete-original | 31.7 | 26.5 | 6.4 | Red chert speckled with white (10R4/3) | sub-triangular |
| d | 10 | edge fragment missing-original | 34.8 | 19.7 | 9.8 | Very dark gray chalcedony (5YR3/1) | elongate |
| e | 14 | complete-original | 23.3 | 24.3 | 10.4 | Reddish gray chert with white inclusions (10R5/1) | sub-rec-tangular |
| f | 43 | distal end-original | -- | 25.0 | 7.4 | Gray chalcedony mottled with brown and white (5YR5/1) | sub-triangular |
| g | 12 | complete-original | 24.6 | 22.7 | 5.2 | Very dark gray chalcedony (5YR3/1) | sub-rec-tangular |
| h | 42 | proximal tip missing-original | -- | 10.3 | 4.8 | Yellowish brown chert (10YR5/4) | elongate |
| i | 11 | | | | | | |
| j | | | | | | | |

**Table 11.** Marginally Retouched Flakes: Formal and Functional Characteristics and Lithology.

| Specimen Number | Modification | Dimensions | | | Lithic Material | Working Edge Shape | Comments/Use Wear |
|---|---|---|---|---|---|---|---|
| | | L | W | T | | | |
| 3 | Unifacial on two edges; bifacial on one edge | 29.7 | 18.8 | 2.4 | Light gray siltstone with larger quartz particles with reddish banding (10YR7/2) | two edges convex, one edge straight | Crushing and smoothing of projections on bifacial edge; step-fractures on unifacial edge |
| 50 | bifacial on one edge | 37.6 | 28.5 | 4.7 | Light gray porcellanite (2.5Y6/0) | slightly concave | Slight crushing of projections, moderate step-fracturing |
| 71 | unifacial on one edge | 58.6 | 48.2 | 10.5 | Gray quartzite (5Y6/1) | straight | Extensive step-fractures and crushing of projections |
| 13 | unifacial on one edge | 43.1 | 23.5 | 10.5 | Light gray porcellanite (5Y6/1) | convex | Slight wear; minimal step-fracturing |
| 45 | unifacial on one edge | 26.5 | 28.5 | 4.7 | Red chert with very faint light mottling (10R4/2) | convex | Slight wear |
| 44 | unifacial on one edge | 24.8 | 17.1 | 4.5 | Lavender chert with white mottling (No Munsell) | straight | Slight wear |
| 11 | bifacial on one edge | 24.6 | 20.3 | 5.7 | Dark yellowish brown chert mottled with black (10YR3/4) | irregular; worked to a point | Projecting tip smooth with some step-fracturing |

**Table 12.** Lithic Debitage Group Distribution.

| Lithic Material | N | Group I | Group II | Group III |
|---|---|---|---|---|
| Chert | 55 | 12(21.8%) | 42(76.4%) | 1(1.8%) |
| Porcellanite | 25 | 7(28.0%) | 14(56.0%) | 4(16.0%) |
| Quartzite | 9 | 1(11.1%) | 8(88.9%) | -- |
| Chalcedony | 6 | 12(18.2%) | 42(63.6%) | 12(18.2%) |
| Obsidian | 7 | 2(28.6%) | 5(71.4%) | -- |
| Dacite | 6 | -- | 2(33.3%) | 4(66.7%) |
| Siltstone | 2 | -- | 22(100%) | -- |
| Total: | 170 | 34(20.0%) | 115(67.6%) | 21(12.4%) |

**Table 13.** Provenience and Frequency Distribution of Area A Ceramics by Surface Treatment and Decoration.

| Provenience | Simple-Stamped/ Smoothed | Trailed/ Incised Decoration | Cord-Impressed Decoration | Weight (gm) | Comments |
|---|---|---|---|---|---|
| 2S 6E | 12<br>Rim #32 | -- | -- | 39.8 | Layer beneath bone midden |
| 2S 8E 'A' | 17 | 4 | 1<br>Rim #1 | 30.6 | Bottom of bone layer |
| 2S 10E | 27 | 6 | Rim #73 | 41.5 | Ceramic Layer I |
| 2S 10E | 7 | -- | -- | 23.3 | Ceramic Layer II |
| 2S 10E | 2 | 1 | | 7.0 | Slough |
| 4S 8E | 15 | -- | -- | 18.9 | Ceramic Layer I |
| 4S 8E | 8 | 3 | | 15.0 | Slough |
| 4S 8E | 15 | 3 | 1 | 23.8 | Preparation area waste |
| 4S 8E 'A' | 7 | 4 | 1 | 15.0 | Wall shape-up |
| 9S 8E | 9 | 6<br>Neck #130 | -- | 25.0 | Wall shape-up |
| Surface | 28 | 27 | -- | 58.0 | |

# Miscellaneous Artifacts

*Leslie B. Davis*

Four artifacts from Area A had been formed from utilized faunal remains: two served as tools, while two others were ornamental. A fifth fragmentary artifact is a stone smoking pipe.

**Polished Elk Tooth.** A polished elk tooth tush, perforated at the root end, was probably worn as a pendant, as part of a necklace, or as a clothing or body ornament (Figure 21c).

**Incised Shell.** A freshwater clam shell fragment with one end incised and snapped off to form a straight edge, that was possibly a knife (Figure 21d).

**Smoking Pipe.** A fragment of a catlinite smoking pipe was recovered. The exterior surface of the tubular fragment was smooth and polished. The interior surface exhibited parallel linear striae and also retained sparse black residues, possibly from smoking tobacco or other vegetative substances (Figure 21b).

Collected by Cramer and Lewis in the 1950s were several artifacts, most likely from Area D: an elongated pebble hammerstone (Figure 22), a possible steatite shaft-smoother (Figure 11), and seven projectile points. Represented are Yonkee, Pelican Lake, and Late side-notched points (Figure 10).

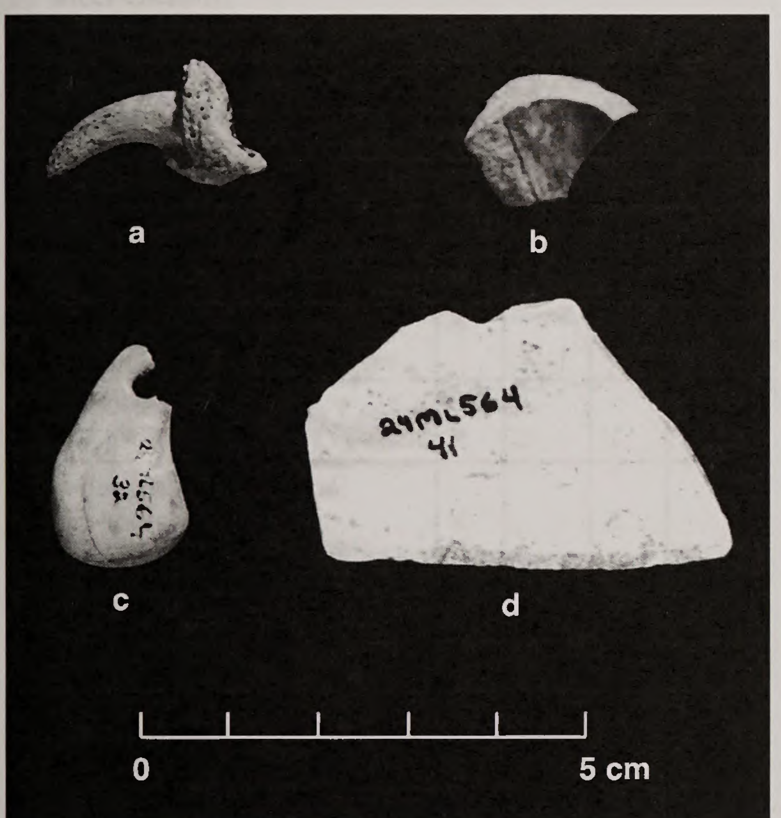



**Figure 21.** Miscellaneous artifacts from Area A: (a) Eagle claw lacking sheath(?) (Specimen #51, A, during preparation); (b) Bone needle (Specimen #36, A-4S4E, upper layer); (c) Elk tooth pendant (Specimen #32, A-4S8E, during preparation); and (d) Mollusc shell knife.

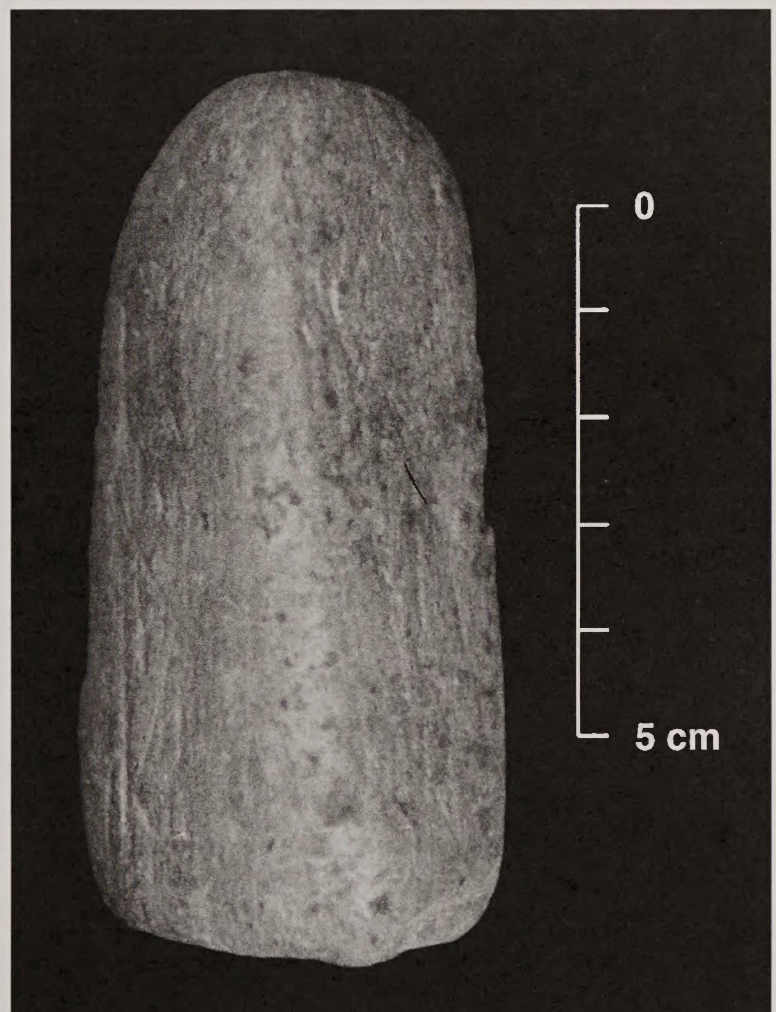



**Figure 22.** Hammerstone from Area D (J. C. Cramer photo).

# Earthenware Ceramics

*Ann M. Johnson*

The ceramic collection (Figure 23) from Area A consists of 210 body sherds, three rims, and one partially reconstructed neck-lower rim-upper shoulder segment. The potsherds were larger than .6 cm square and weighed 274.6 gm.

The potsherds were recovered under three kinds of circumstances in Area A: from the surface, as collections made by different people at different times; from cutbank slough and by excavation wall shape-up; and by excavation. These data are summarized in Table 14. While potential microstratigraphic differences, as indicated by field designations as "Ceramic Layer I" or "II," are noted in Table 14 (also see Figure 25), analysis indicated that both of these provisionally defined "layers" are products of a single, probably short-term occupation that had been disturbed locally by sheet erosion.

**Table 14. Area A Ceramic Vessel Attribute Frequency Distribution.**

| Attributes/Vessel | #1 | #32 | #73 | #130* |
|---|---|---|---|---|
| Exterior finish: | | | | |
| Smoothed | X | | X | X |
| Simple-stamped | | X | | |
| Rim profile: | | | | |
| Straight | X | X | X | X |
| Rim decorative technique: | | | | |
| Cord-impressed | X | | X | |
| Trailed | | | | X |
| Rim decorative motif: | | | | |
| Multiple horizontal rows | 3 | | 5+ | ? |
| Interior finish: | | | | |
| Smoothed | X | X | X | X |
| Lip profile: | | | | |
| Flattened | | X | X | |
| Sub-rounded | X | | | |
| Lip decorative technique: | | | | |
| Incised | | | X | |
| Lip decorative motif: | | | | |
| Diagonal parallel lines | | | X | |
| Lip surface treatment: | | | | |
| Smoothed | X | X | X | |
| Orientation of lip to horizontal: | | | | |
| Horizontal | X | X | | |
| Out | | | X | |

*Neck, missing upper rim and lower shoulder.

## Description

### Sample

210 sherds, including three rims and one neck (Figures 23-24), represent a minimum of four vessels.

### Method of Manufacture

Recent breaks camouflage original breaks along weak lines such as coil welds; however, coils were not in evidence. The vessels are assumed to have been lump modeled and finished by paddle and anvil.

### Temper

Crushed granite, ranging from .7 to 4 mm, with most 1 to 1.5 mm in diameter.

### Clay

Assumed to be local in origin; no specific analyses attempted.

### Hardness

3 to 4 (Moh's scale).

### Texture

Temper was well mixed with the clay. Rim 1 and Neck 130 have cracks parallel to the surfaces, while Rim 73 and the majority of the body sherds are very compact and have a fine paste. The paste was oriented with the direction of the vessel surfaces, but this orientation is not strong enough to be called laminated. About half of the sherds tended to break straight across, with equal amounts of exterior and interior surface remaining. Many of the other sherds had split along the core, leaving a long interior or exterior surface.

### Color

Dark browns to black, with a few tan sherds. Some exteriors are light with dark cores and interior surfaces, while other sherds are of a single color. Some surfaces have a thin black charred material adhering to them. The sherds are too small to allow for identification of firing clouds.

### Surface Treatment

Various parts of the vessel had been treated differently. The late stages of production included shaping and compacting the vessel walls with a simple-stamped paddle. A partial set of prints from the paddle indicate that the stamp impres-

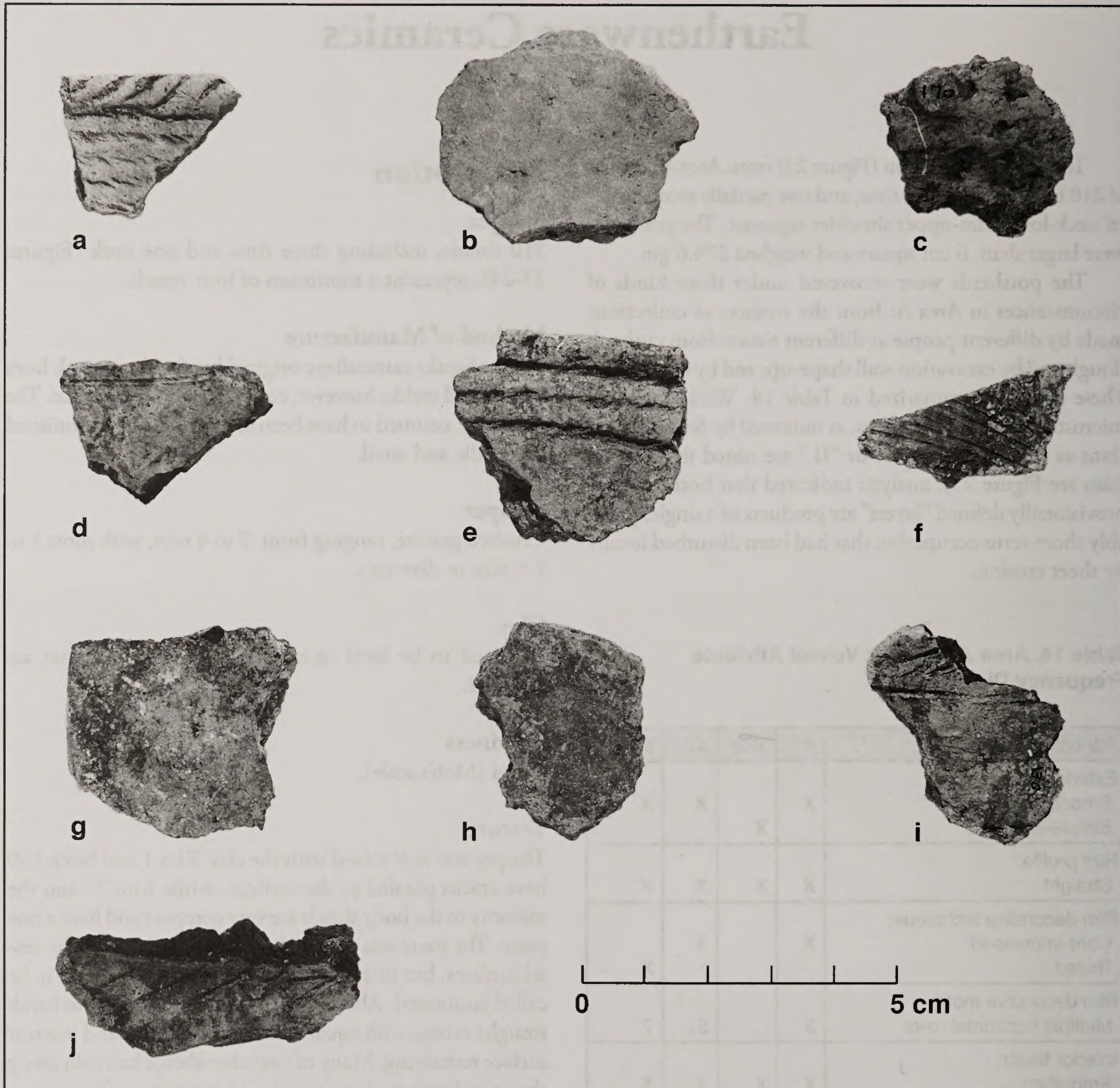



**Figure 23.** Area A potsherds: (a) Rim sherd with parallel, diagonal incising on lip and parallel, horizontal twisted cord-impressions on neck (Specimen #73, A-2S10E), Ceramic Layer I); (b) Body sherd with paddle-smoothed surface (Specimen #35, A-0S6E, during preparation); (c) Body sherd with cord-marked impressions (Specimen #170, A-2S10E, during preparation); (d) Neck sherd with horizontal, parallel incising (Specimen #132, A-4S8E, during preparation; (e) Rim sherd with horizontal, twisted cord-impressions (Specimen #1, A-2S8E, base of upper bone layer); (f) Neck sherd with parallel, horizontal incising intersected by parallel, diagonal incised lines (Specimen #93, A-2S10E, Ceramic Layer I); (g) Rim sherd with plain, undecorated straight rim (Specimen #32, A-2S6E, base of upper bone layer); (h) Body sherd with brushed surface (Specimen #176, A-4S8E, during preparation); (i) Neck sherd with parallel, incised diagonal lines (Specimen #130, A-4S8E, during preparation); and (j) Base of neck sherd with short, diagonal lines intersecting horizontal incised lines (Specimen #131, A-4S8E, during preparation).

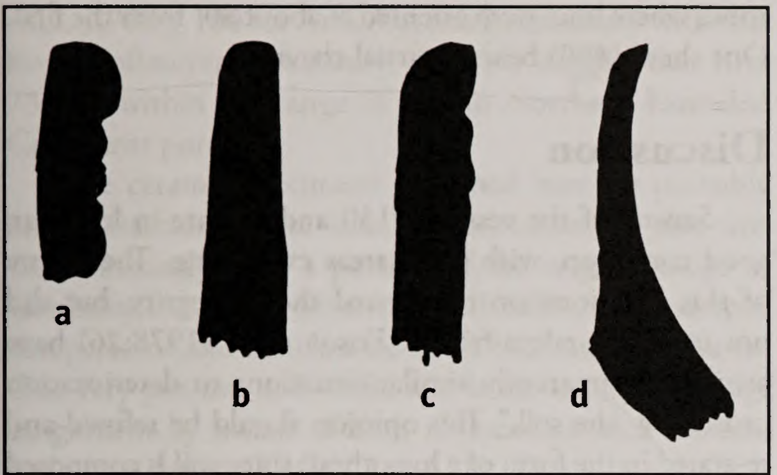



**Figure 24.** Area A potsherd rim types (3 rim and 1 neck sherds): a=73; b=32; c=1; and d=130/131 (interiors to left).

sion was 5 mm wide, with grooves 4-5 mm apart, with a length greater than 8 mm and .7 mm deep. One step involved smoothing of the rim and shoulder, probably in preparation for decoration; hence, the simple stamped and smoothed sherds both may represent the same vessel. Many sherds are too small to be confidently placed in one category or another.

The interior rim was also smoothed; horizontal striae from this activity are evident.

## Rim 1

**Description:** The rim is straight and tapered slightly toward the lip, which was sub-rounded (Table 15). The rim (Figure 24c) was incompletely smoothed prior to decoration. The application of cord impressions immediately below the lip creates the impression that the lip "rolls" slightly outward. The three cord-impressed rows are parallel and horizontal, approximately 5 mm apart. The 2-ply cord twist is of the Z type. The first and third rows were impressed to a depth of 1.4 mm, and the middle row is impressed approximately .9 mm. The cord was pushed into the clay with hand and fingers. Several fingernail impressions are evident perpendicular to the direction of the cord. The core and surfaces are black.

**Metric Attributes:** Lip: 7.2 mm wide; rim: 5.8 mm wide and 22 mm tall.

**Provenience:** XU 2S10E, Ceramic Layer I.

## Rim 32

**Description:** This undecorated rim had a slight inward curve in an otherwise straight, tall profile (Figure 24d). The lip was flattened. Diagonal simple-stamped impressions are visible on the exterior. Charred material adhered to the interior. The rim widened slightly toward the neck. The core is gray, and the exterior and interior are brown.

**Metric Attributes:** Lip: 6.1 mm wide; rim: 9 mm wide and 35 mm tall.

**Provenience:** XU 2S6E, 42 cm b.s., 164 cm E, and 31 cm S.

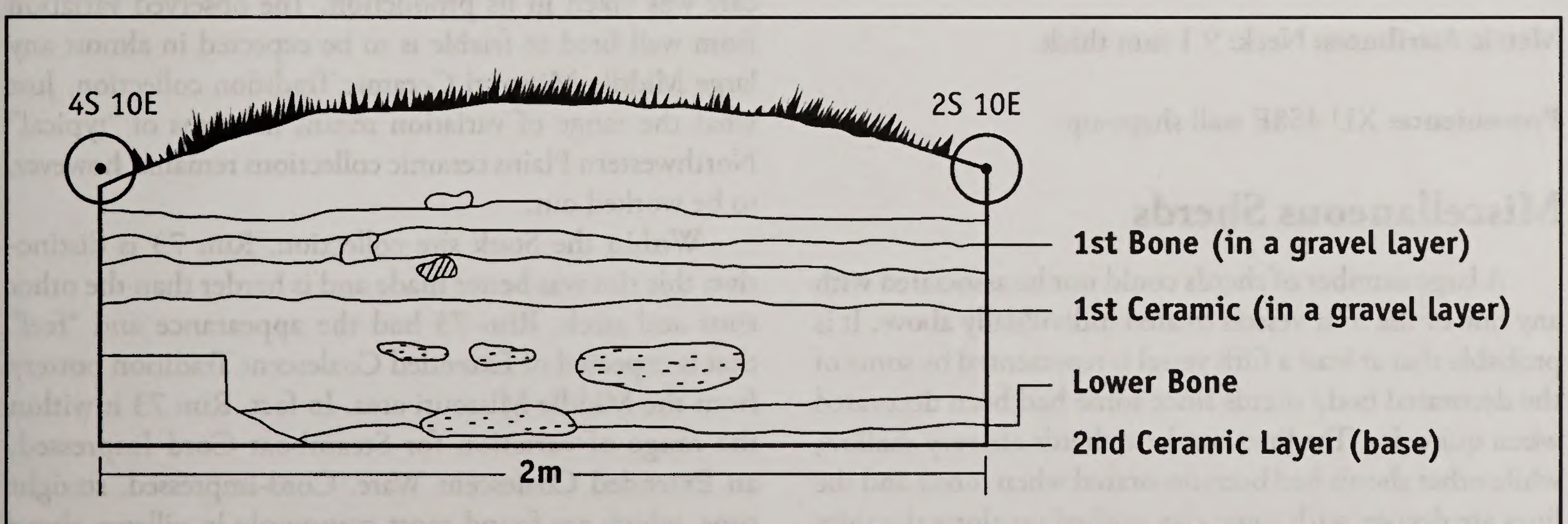



**Figure 25.** Stratigraphic detail of potsherd and bone proveniences along the channel in Area A.

### Rim 73

**Description:** The profile was slightly outcurving with a braced appearance created by extra clay rolled from the lip outward (Figure 24a). This brace was decorated with incised upper right to lower left diagonal lines. The lip was flattened after incising. The rim was decorated by 5+ parallel rows of cord impressions approximately 3.6 mm apart and .5 mm deep. The cord is two-ply with an S twist. The twist of the individual strands could not be determined. The core is dark gray and the surfaces are brown.

**Metric Attributes:** Lip: 7.2 mm wide; rim: 5.8 mm wide and 22 mm tall.

**Provenience:** XU 2S10E, Ceramic Layer I.

### Neck 130

**Description:** This sherd is from the neck region of a vessel that had rim and shoulder decoration, with a trailed diagonal line pattern. The best guess at the orientation is shown in Figure 24d. A line that encircled the neck was composed of a number of stops and starts with a tool. Below this is a band of short diagonal lines about 14 mm long. There is a suggestion that additional decoration had been located on the shoulder. The "rim" portion had two trailed lines oriented upward and slightly at the diagonal. The core and surfaces are black. This specimen was incompletely smoothed prior to design application. The specimen was not friable, but its integrity was threatened since multiple cracks parallel to the vessel surfaces are present.

**Metric Attributes:** Neck: 9.1 mm thick.

**Provenience:** XU 4S8E wall shape-up.

## Miscellaneous Sherds

A large number of sherds could not be associated with any one of the four vessels treated individually above. It is probable that at least a fifth vessel is represented by some of the decorated body sherds since some had been decorated when quite dry. The lines on these sherds are very shallow, while other sherds had been decorated when moist and the lines are deeper, with some clay pushed up along the sides of the lines.

Little of the decorative patterns could be reconstructed due to the small size of the sherds. However, fragments of the parallel trailed line arrangements did appear consistently. Some areas that bear these lines intersected with zones where lines were oriented at about 80° from the first. One sherd (#50) bears a partial chevron.

## Discussion

Several of the vessels (#130 and #1) are in less than good condition, with some areas exfoliating. The nature of this deterioration threatened their integrity, but did not make the edges friable. Frison et al. (1978:26) have attributed apparently similar situations to deterioration caused by "the soil." This opinion should be refined and re-stated in the form of a hypothesis since soil is composed of a multitude of materials and chemicals, both inert and active. Alternatively, wetting and drying cycles may cause salts in the soil to be deposited on sherds, causing minute cracks to enlarge over time. Additionally, one must be careful to separate post-depositional breakage from failure to complete fuse due to insufficient firing temperatures and from weakening of the pottery by such factors as secondary deposition of chemicals. We know that chemical compounds move through the soil, and it may be that one or more may react with the components in fired clay under all or some conditions. Test implications can be identified for these alternatives and the sophisticated equipment needed to conduct these tests is available. Research on the causes of post-depositional ceramic modification would be interesting and useful.

The upper and lower "ceramic components" at Stark were not distinguishable, based on ceramic paste attributes, which supports the designation of single component.

The Stark site pottery was generally adequately well made and fired. An adequate, but not excessive amount of care was taken in its production. The observed variation from well-fired to friable is to be expected in almost any large Middle Missouri Ceramic Tradition collection. Just what the range of variation means in terms of "typical" Northwestern Plains ceramic collections remains, however, to be worked out.

Within the Stark site collection, Rim 73 is distinctive; this rim was better made and is harder than the other rims and neck. Rim 73 had the appearance and "feel" that is expected of Extended Coalescent Tradition pottery from the Middle Missouri area. In fact, Rim 73 is within the range of variation for Steamboat Cord Impressed, an Extended Coalescent Ware. Cord-impressed, straight rims, which are found most commonly in villages above the Cheyenne River, are characteristic of the northern Extended Coalescent (Lehmer 1971:118). The Nollmeyer site (24BW225) (Johnson 1982; Krause 1995; Johnson et al. 1990) is a Northern Extended Coalescent village near Sidney, Montana, that dates ca. A.D. 1,700. The date of

A.D. 1,700 ± 100 for Area A at Stark fits closely with that from Nollmeyer. Cautiously, then, we suggest that Rim 73 falls within the range of certain Northern Extended Coalescent pottery.

The ceramic specimens described here are probably only a fraction of the vessels once utilized at this site. Concomitantly, only a portion of the original range of variability is available for study. With such a small sample, comparisons and conclusions must be cautiously drawn. One very positive and useful fact is the independent age assignment by means of both radiocarbon and obsidian hydration dating (Tables 27 and 28). Those time controls will greatly assist in the making of future comparisons.

The date of A.D. 1,700 ± 100 places the Stark ceramics contemporaneous with those at Cluny (Forbis 1977), Nollmeyer (Johnson 1982; Krause 1995), and perhaps sites ascribed to the Mortlach phase (Joyes 1973). Nollmeyer is an earthlodge village with a fortifaction ditch of the Northern Extended Coalescent people (Johnson et al. 1990). Unfortunately, this is one of the least well-studied "cultures" in the Middle Missouri area. The Stark pottery could be "lost" in the much larger Nollmeyer collection.

The Nollmeyer site represents a group of people who left the Middle Missouri villages and established a new village in a "frontier" area. It is not certain whether the Nollmeyer inhabitants continued to have gardens in their new location, but they did successfully hunt bison. The Stark Bison Kills may be a special-purpose site utilized by Northern Extended Coalescent peoples while on the Northwestern Plains.

In sum, the Stark site pottery is identified as Northern Extended Coalescent. The Stark sherds thus add yet another piece to this persisting, perplexing problem of regional and inter-regional ceramic affiliations.

# The Bone Artifact Assemblage

*John W. Fisher, Jr.*

Bone artifacts were found in both Areas A and B, with the majority recovered from Area A (Figure 26). Twenty-one artifacts made from bison rib midshafts vary in length from 42.05 to 133.75 mm. One artifact (A-83) was made from the rib midshaft of an animal approximately the size of a large canid or deer. One piece consists of the distal end of a bison metatarsal.

Seven categories of bone artifacts are distinguished on the basis of morphological variation. Table 16 lists the artifacts, their lengths, and artifact categories. The grooved-and-snapped rib midshaft without further modification category comprises 13 of the pieces (Category 1) (Figure 27), although grooving and snapping are evident on five more pieces. The worked end appears to have been formed by grooving about halfway through the rib wall, completely around the rib circumference. The piece was then snapped to obtain a rib section with a clean break. None of the bones were grooved and snapped at both ends. Five artifacts occur in this largest category in which the cancellous bone had been removed at the grooved end, approximately .5 cm into the shaft. Although some might be attributed to natural erosion of bone, all but one of the other artifacts has cancellous bone exposed along the entire length of the fragment. While bone removal may have been deliberate, its intent is unclear.

Four grooved and snapped bone artifacts also show utilization in the form of polished, rounded ends opposite the cut (Category 2). These pieces are uniform in length (6.8-9.6 cm). The rounded ends are green bone breaks with slight rounding and a smooth, polished appearance. One piece has gouged cancellous tissue, as noted for the five tools in Category 1.

Category 3 includes those artifacts that show one rounded end and no grooving and that had been made from lengthwise-split rib fragments (Figure 26f). The only bone artifacts from Area B fall into this category. On three artifacts, only one end had been polished and rounded, and it is questionable whether the fourth has two utilized ends. Three pieces clusters around 6 cm in length, while the fourth is 13.3 cm long. The three shorter pieces, however, show some indications of recent breakage and crumbling of the non-utilized end, indicating that the original artifact might have been longer.

**Table 15.** Bone Artifact Description and Classification.

| Catalog # | Length (mm) | Category |
|---|---|---|
| A-60 | 61.4 | 1 |
| A-61 | 85.3 | 2 |
| A-62 | 155.4 | 1 |
| A-63 | 133.4 | 3 |
| A-64 | 144.4 | 1 |
| A-65 | 54.0 | 3 |
| A-66 | 96.6 | 2 |
| A-67 | --[1] | 1 |
| A-68 | 50.7 | 1 |
| A-69 | 116.2 | 1 |
| A-70 | 61.2 | 4 |
| A-71 | -- | 1 |
| A-72 | 86.4 | 1 |
| A-73 | 42.1 | 1 |
| A-74 | 68.6 | 1 |
| A-75 | 76.2 | 2 |
| A-76 | -- | 1 |
| A-77 | 95.1 | 1 |
| A-78 | 77.3 | 5 |
| A-79 | 90.6 | 2 |
| A-80 | 25.9 | 6 |
| A-81 | 73.1 | 7 |
| A-82 | 121.7 | 1 |
| A-83 | 60.9 | 1 |
| B-1 | -- | 3 |
| B-2 | -- | 3 |

**Category descriptions:**

1 - grooved and snapped rib midshaft with no further modification.
2 - grooved and snapped rib midshaft with polished opposite end.
3 - rib midshaft split lengthwise and with polished end.
4 - grooved and snapped rib midshaft with notched sides.
5 - grooved bison metatarsal.
6 - perforated flat bone fragment with notched sides.
7 - split and polished proximal end of metatarsal with one tapered end.

[1]Missing data means that recent breakage precluded measurement of original length.


**Figure 26.** Bone artifacts from Areas A and B (a-h).

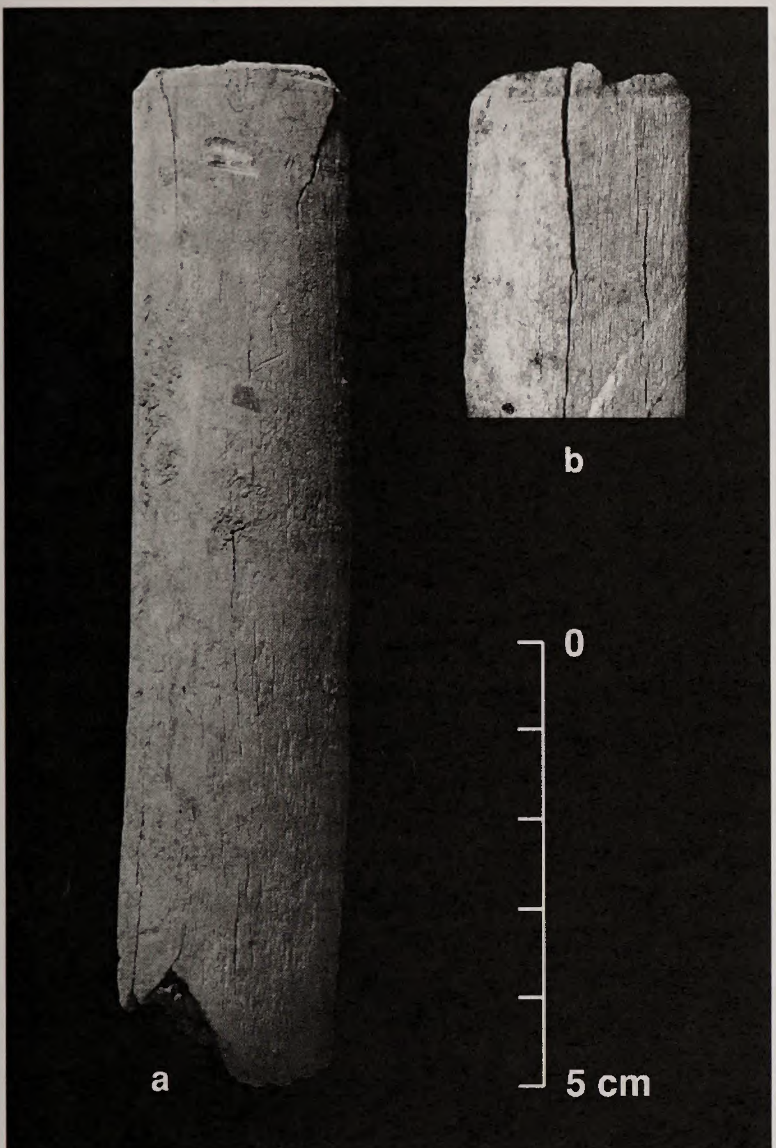


**Figure 27.** Area A: grooved and snapped ribs (A-82) and (A-69).

A single rib artifact (Category 4) out of the entire rib collection displays two rows of notches (Figure 26b). This piece had been badly weathered, but a trace of grooving and cutting remains on one end. Small notches placed fairly evenly down the whole length of both edges of the rib fragment consist of two sets of 10 notches over a length of 6 cm. The purpose of notching is unknown.

One of the two or three non-rib bone artifacts in the collection is a distal end of a metatarsal (Figure 26a). The broken edge shows no rounding or polishing. An incision had been grooved 52.3 mm from the distal end, almost completely around the bone; however, the bone had not been snapped. No other marks or use wear are present on this artifact.

The one artifact in Category 6 reflects multiple steps in production. This small (25.9 mm) flat piece, formed from an unidentifiable bone fragment (2.7 mm thick), is smooth on one side, but rougher on the obverse. It was shaped into uniform width, rounded on one end, notched on either side, as seen in Category 4, and a tiny (1.5-mm) hole was drilled from the rough to the smooth side, located at the rounded end (Figure 26g). Unfortunately, the opposite end had been broken away, leaving the function of this artifact unclear.

Finally, Category 7, is designated a non-bison bone artifact: it is the proximal end of a medium-sized artiodactyl metatarsal, split lengthwise and tapered to form a tip (Figure 26c). Measuring 75.05 mm, the artifact originally was probably slightly longer since the tip was broken recently. Smooth polishing is apparent from the tip to nearly halfway to the metatarsal proximal end. Diagonal striae are present on the internal bone face from the tip for a distance of 16 mm.

# The Archaeological Fauna

*John W. Fisher, Jr. and Helen C. Strickland*

## Introduction

Faunal remains were recovered from Areas A and B (Table 16). Since the use of those two areas was historically and culturally distinct, the bones from each were analyzed as independent assemblages. Within the archaeological deposits in each area, excavation defined only a single stratum. The assemblages from each area are not, therefore, divided into subassemblages. Interpretations are based on the assumption that the bison assemblages are representative samples of the entire bone deposit in each area, and of activities performed in each.

Bison remains dominate the assemblages numerically, but non-bison species occur in both areas. The bison remains from each area are discussed separately with regard to butchering and processing. Carcass utilization is analyzed and interpreted in each case by reference to the represented skeletal parts, the location of cut marks and impact scars, and bone breakage patterns. The two areas are then compared to discern differences and similarities in methods of bison butchering and processing.

Evidence for scavenging by carnivores is available in both areas. This evidence is discussed and the potential impact of scavenging on the bison assemblages assessed.

Fetal bison bones were found only in Area A. These are reported separately with regard to seasonality. Bison teeth are analyzed for indications of season of death. Several anomalies and pathologies on bison teeth and bones are noted.

Non-bison species at the site include mussel, pocket gopher (*Thomomys* sp.), swift fox (*Vulpus velox*), large canids (*Canis* sp.), elk (*Cervus elaphus*), and a medium-sized (i.e., deer-sized) artiodactyl. All but the large canids are scantily represented.

## Stark Bison Bone Assemblages

### Area A Bison

At least 19 bison are represented by bones and dentitions from Area A. This minimum number of individuals (MNI) count derives from left metatarsals: one intact plus 18 proximal ends (Table 17). It does not include the fetal bison remains, which are discussed separately. Table 17 presents the count of skeletal elements (MNE), the minimum number of individuals (MNI) represented by each element, the frequency of individuals represented by each element (MNE) relative to the inferred minimum of 19 animals represented, and the minimum animal units (MAU) represented for skeletal elements. MAU differs from MNI in that, for calculating the former, the values for left and right sides of an element are summed. This value is divided by the number of left and right elements in a complete skeleton. For discussions of methods of quantifying skeletal remains, see Binford (1984), Klein and Cruz-Uribe (1984), and Todd (1987).

The Area A bones are fairly well preserved. They are durable and the outer surface of most had been only slightly weathered; a small part of the assemblage had been more severely weathered. Post-depositional and recent breakage exaggerate the number of small bone fragments, and the more fragile large bones, such as scapulae, innominates, and ribs, show post-depositional breakage. Isolated teeth give a higher count of individuals than do other parts of the cranium and dentary, which indicates deterioration of the skulls. Thus, it is possible that such deterioration had affected other parts of the assemblage to a greater extent than is evident.

**Table 16.** Stark Site Species List.

**Class Pelecypoda**
- Mussel (cf. *Margaratifera margaratifera* or *Lampsilis siliquoidea*)

**Class Aves**
- Eagle (cf. *Haliaeetus leucocephalus* [Bald Eagle] or *Aquila chrysaetos* [Golden Eagle])

**Class Mamalia**
- Order Rodentia
  - Pocket Gopher (*Thomomys* sp.) probably recent intrusive
  - Unidentified rodent, probably recent intrusive
- Order Carnivora
  - Fox (*Vulpes velox*)
  - Canid (cf. *Canis familiaris*)
- Order Artiodactyla
  - Elk (*Cervus elaphus*)
  - Bison (*Bison bison bison*)
  - Artiodactyl (cf. *Antilocapra americana* or cf. *Odocoileus ssp.*)

Cut marks from stone tools, and conchoidal flake scars on bones from hammerstone impact, attest to carcass processing by humans (see Fisher 1995). In addition, carnivores apparently had scavenged this bone assemblage, as is indicated by scoring, pitting, and furrowing marks on several of bones. Scavenging is discussed in more detail below.

The following description and discussion of bison bone excludes the fetal bison remains, which are treated separately farther on.

**Table 17.** Frequency of Bison Skeletal Elements from Area A.

| Element | Side | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Cranium: | | | | | |
| maxilla | L | 3 | 3 | 15.8 | 2.5 |
| | R | 2 | 2 | 10.5 | |
| premaxilla | L | 3 | 3 | 15.8 | 2 |
| | R | 1 | 1 | 5.3 | |
| orbit | L | 1 | 1 | 5.3 | 2 |
| | R | 0 | 0 | 0 | |
| | U* | 3 | 2 | 10.5 | |
| nasal | L | 2 | 2 | 10.5 | |
| | R | 1 | 1 | 5.3 | 1.5 |
| occipital condyle | U | 1 | 1 | 5.3 | .5 |
| Mandible: | | | | | |
| asc. ramus | L | 6 | 6 | 31.6 | 6.5 |
| | R | 7 | 7 | 36.8 | |
| incisor end | L | 7 | 7 | 36.8 | 7 |
| | R | 7 | 7 | 36.8 | |
| Hyoid | L | 3 | 3 | 15.8 | 4.5 |
| | R | 3 | 3 | 15.8 | |
| | U | 3 | 2 | 10.5 | |
| Vertebrae: | | | | | |
| Atlas | | 3 | 3 | 15.8 | 3 |
| Axis | | 0 | 0 | 0 | 0 |
| Cervical 3-7 | | 6 | 1 | 6.3 | 1.2 |
| Thoracic | | 12 | .9 | 4.7 | .9 |
| Lumbar | | 6 | 1.2 | 6.3 | 1.2 |
| Sacrum | | 0 | 0 | 0 | 0 |
| Caudal vertebra | | 4 | .3 | 1.6 | .3 |
| Ribs: | | | | | |
| vertebral end | | 33 | 1.2 | 6.3 | 1.2 |
| sternal end | | 18 | .64 | 3.4 | .64 |
| Scapula: | | | | | |
| complete | L | 1 | 1 | 5.3 | 1 |
| | R | 1 | 1 | 5.3 | |
| glenoid | L | 4 | 4 | 21.1 | 4.5 |
| | R | 5 | 5 | 26.3 | |
| blade | L | 3 | 3 | 15.8 | 2.5 |
| | R | 2 | 2 | 10.5 | |
| Humerus: | | | | | |
| proximal | L | 0 | 0 | 0 | 0 |
| | R | 0 | 0 | 0 | 0 |
| distal | L | 7 | 7 | 36.8 | 6.5 |
| | R | 6 | 6 | 31.6 | |
| shaft | L | 4 | 4 | 21.1 | 8 |
| | R | 10 | 10 | 52.6 | |
| | U | 2 | 1 | 5.3 | |
| Radius: | | | | | |
| proximal | L | 16 | 16 | 84.2 | 15 |
| | R | 14 | 14 | 73.7 | |
| distal | L | 7 | 7 | 36.8 | 6.5 |
| | R | 6 | 6 | 31.6 | |
| shaft | L | 0 | 0 | 0 | .5 |
| | R | 0 | 0 | 0 | |
| | U | 1 | 1 | 5.3 | |
| Ulna-proximal | L | 15 | 15 | 78.9 | 12.5 |
| | R | 9 | 9 | 47.4 | |
| | U | 1 | 1 | 5.3 | |
| Carpals: | | | | | |
| intermediate | L | 8 | 8 | 42.1 | 6 |
| | R | 4 | 4 | 21.1 | |
| radial | L | 9 | 9 | 47.4 | 6.5 |
| | R | 4 | 4 | 21.1 | |
| ulnar | L | 7 | 7 | 36.8 | 9 |
| | R | 11 | 11 | 57.9 | |
| 2+3 | L | 4 | 4 | 21.1 | 3 |
| | R | 2 | 2 | 10.5 | |
| 4th | L | 7 | 7 | 36.8 | 6 |
| | R | 5 | 5 | 26.3 | |
| Accessory | L | 1 | 1 | 5.3 | 2.5 |
| | R | 4 | 4 | 21.1 | |
| Metacarpal: | | | | | |
| complete | L | 0 | 0 | 0 | 1 |
| | R | 2 | 2 | 10.5 | |
| proximal | L | 13 | 13 | 68.4 | 10 |
| | R | 7 | 7 | 36.8 | |

| | | | | | |
|---|---|---|---|---|---|
| distal | L | 0 | 0 | 0 | 4 |
| | R | 0 | 0 | 0 | |
| | U | 8 | 4 | 21.1 | |
| shaft | L | 0 | 0 | 0 | 2 |
| | R | 0 | 0 | 0 | |
| | U | 4 | 2 | 10.5 | |
| **Innominate:** | | | | | |
| | L | 6 | 6 | 31.6 | 6 |
| | R | 6 | 6 | 31.6 | |
| **Femur:** | | | | | |
| proximal | L | 0 | 0 | 0 | 2.5 |
| | R | 3 | 3 | 15.8 | |
| | U | 2 | 2 | 10.5 | |
| distal | L | 0 | 0 | 0 | .5 |
| | R | 1 | 1 | 5.3 | |
| shaft | L | 2 | 2 | 10.5 | 4 |
| | R | 4 | 4 | 21.1 | |
| | U | 2 | 1 | 5.3 | |
| **Tibia:** | | | | | |
| proximal | L | 0 | 0 | 0 | 0 |
| | R | 0 | 0 | 0 | 0 |
| distal | L | 16 | 16 | 84.2 | 13 |
| | R | 10 | 10 | 52.6 | |
| shaft | L | 4 | 4 | 21.1 | 6 |
| | R | 5 | 5 | 26.3 | |
| | U | 3 | 3 | 15.8 | |
| **Patella:** | | | | | |
| | L | 4 | 4 | 21.1 | 3 |
| | R | 2 | 2 | 10.5 | |
| **Tarsals:** | | | | | |
| astragalus | L | 9 | 9 | 47.4 | 8 |
| | R | 7 | 7 | 36.8 | |
| calcaneus | L | 7 | 7 | 36.8 | 8.5 |
| | R | 10 | 10 | 52.6 | |
| naviculo-cuboid | L | 15 | 15 | 78.9 | 13.5 |
| | R | 12 | 12 | 63.2 | |
| tarsal 2+3 | L | 14 | 14 | 73.7 | 11 |
| | R | 8 | 8 | 42.1 | |
| Lateral malleolus | L | 6 | 6 | 31.6 | 12 |
| | R | 18 | 18 | 94.7 | |
| **Metatarsal:** | | | | | |
| complete | L | 1 | 1 | 5.3 | .5 |
| | R | 0 | 0 | 0 | |
| proximal | L | 18 | 18 | 94.7 | 14.5 |
| | R | 11 | 11 | 57.9 | |
| distal | L | 0 | 0 | 0 | 8 |
| | R | 2 | 2 | 10.5 | |
| | U | 14 | 7 | 36.8 | |
| shaft | L | 0 | 0 | 0 | .5 |
| | U | 1 | 1 | 5.3 | |
| **1st Phalanx:** | | | | | |
| complete | L | 13 | 3.3 | 17.4 | 2.9 |
| | R | 10 | 2.5 | 13.2 | |
| proximal | L | 1 | .25 | 1.3 | .1 |
| | R | 0 | 0 | 0 | |
| distal | L | 1 | .3 | 1.6 | .3 |
| | R | 1 | .3 | 1.6 | |
| **2nd Phalanx:** | | | | | |
| complete | L | 3 | .8 | 4.2 | 1.8 |
| | R | 11 | 2.8 | 14.7 | |
| proximal | L | 0 | 0 | 0 | 0 |
| | R | 0 | 0 | 0 | 0 |
| distal | L | 1 | .3 | 1.6 | .3 |
| | R | 1 | .3 | 1.6 | .3 |
| **3rd Phalanx:** | | | | | |
| complete | L | 14 | 3.5 | 18.4 | 3.5 |
| | R | 14 | 3.5 | 18.4 | |
| **Sesamoid:** | | | | | |
| distal | | 5 | .6 | 3.2 | .6 |
| proximal | | 8 | .5 | 2.6 | .5 |

1 = minimum number of elements (MNE).
2 = minimum number of individuals (MNI).
3 = (MNI divided by 19) x 100.
4 = minimum animal units (MAU). Note that, for paired elements, the MAU value represents the sum of the MNE values for the left and right sides, which is then divided by the number of left and right elements in a complete skeleton. Because MAU does not distinguish between left and right sides, for paired elements, only one value is reported.
*U = side unknown (indeterminate)

## Description of Bison Skeletal Parts, Area A

**Cranium.** Since all skulls are very fragmentary, an accurate count of the number of individuals represented is not possible. Loose, isolated teeth are the most numerous cranial element. About 32 percent of the MNI of 19 is represented by teeth.

Cranial parts in the assemblage include maxilla, premaxilla, orbit, nasal bones, petrous elements, and occipital condyles. No horn cores were identified. The nature of

**Table 18.** Areas A and B Bison Long Bone Length (mm).

| Element (unsplit) | N | Min | Max | Mean | SD* | CV (%)** |
|---|---|---|---|---|---|---|
| Distal radius | 5 | 82 | 176 | 130.80 | 40.95 | 31.30 Area A |
| Prox radius | 22 | 60 | 174 | 119.90 | 29.29 | 24.43 Area A |
| Distal humerus | 10 | 88 | 221 | 140.10 | 44.40 | 31.69 Area A |
| Distal metacarpal | 6 | 73 | 149 | 110.83 | 30.20 | 27.25 Area A |
| Prox. metatarsal | 11 | 59 | 104 | 72.90 | 18.61 | 25.53 Area A |
| Distal metatarsal | 8 | 81 | 182 | 126.75 | 32.60 | 25.72 Area A |
| Prox. metatarsal | 12 | 44 | 150 | 103.75 | 34.75 | 33.49 Area A |
| Distal tibia | 17 | 98 | 191 | 144.35 | 29.91 | 20.72 Area A |
| Distal metatarsal | 4 | 110 | 167 | 137.00 | 23.62 | 17.24 Area B |
| Prox. metatarsal | 3 | 120 | 131 | 124.00 | 6.08 | 4.90 Area B |
| Distal tibia | 4 | 122 | 146 | 126.50 | 13.70 | 10.83 Area B |

breakage of the cranium by the people using the bison carcasses could not be determined because of post-depositional and recent breakage.

**Dentary.** Intact dentaries are not present in the assemblage. Recurring dentary parts include the ascending ramus, the horizontal ramus broken at the diastema between the cheek teeth and incisor teeth, and the incisor teeth alveoli and diastema. The dentaries show considerable post-depositional breakage. Most of the teeth occur as isolated specimens. Teeth represent about 42 percent of the MNI.

Cut marks occur on the diastema of one left and two right dentaries (Figure 28), on and adjacent to the ventral border. One right dentary also has cut marks on the medial side of the gonial angle. Another right dentary has cuts on the lateral side just above the gonial angle, and a left coronoid process shows cut marks (Figure 28).

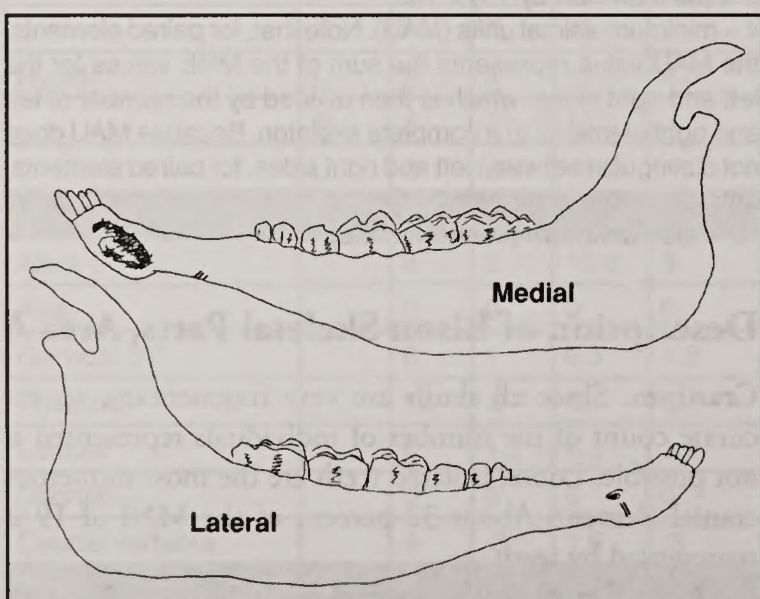



**Figure 28.** Location of cut marks (/) on bison dentaries from Area A (composite).

**Hyoid.** Hyoids lack cut marks.

**Vertebrae.** The three atlas vertebrae are intact, and lack cut marks. The cervical, thoracic, and lumbar vertebrae are fragmentary, but breakage may have occurred post-depositionally. Cut marks occur on the transverse process of one lumbar vertebra.

**Rib.** Intact ribs are not present in the assemblage. Rib parts include the vertebral extremity with adjoining rib shaft, the sternal extremity with adjoining shaft, and midshaft fragments. However, the ribs have undergone considerable post-depositional cracking, splitting, and breaking. Thus, the high number of rib midshaft fragments is misleading as regards the number of ribs present in the assemblage. The assemblage contains 33 right and left vertebral extremities of ribs and 18 right and left sternal extremities. This number of rib ends represents a minimum of two bison. A total of 1,429 midshaft fragments are present; however, 1,205 are small fragments that show recent splitting and breakage. The remaining 224 midshaft fragments are relatively large and, as a group, they show little recent splitting and breakage. While it is impossible to estimate accurately the number of ribs represented by midshaft fragments, it seems reasonable to estimate that they represent a low number similar to that evident from a count of vertebral and sternal extremities. Cut marks occur on several rib fragments.

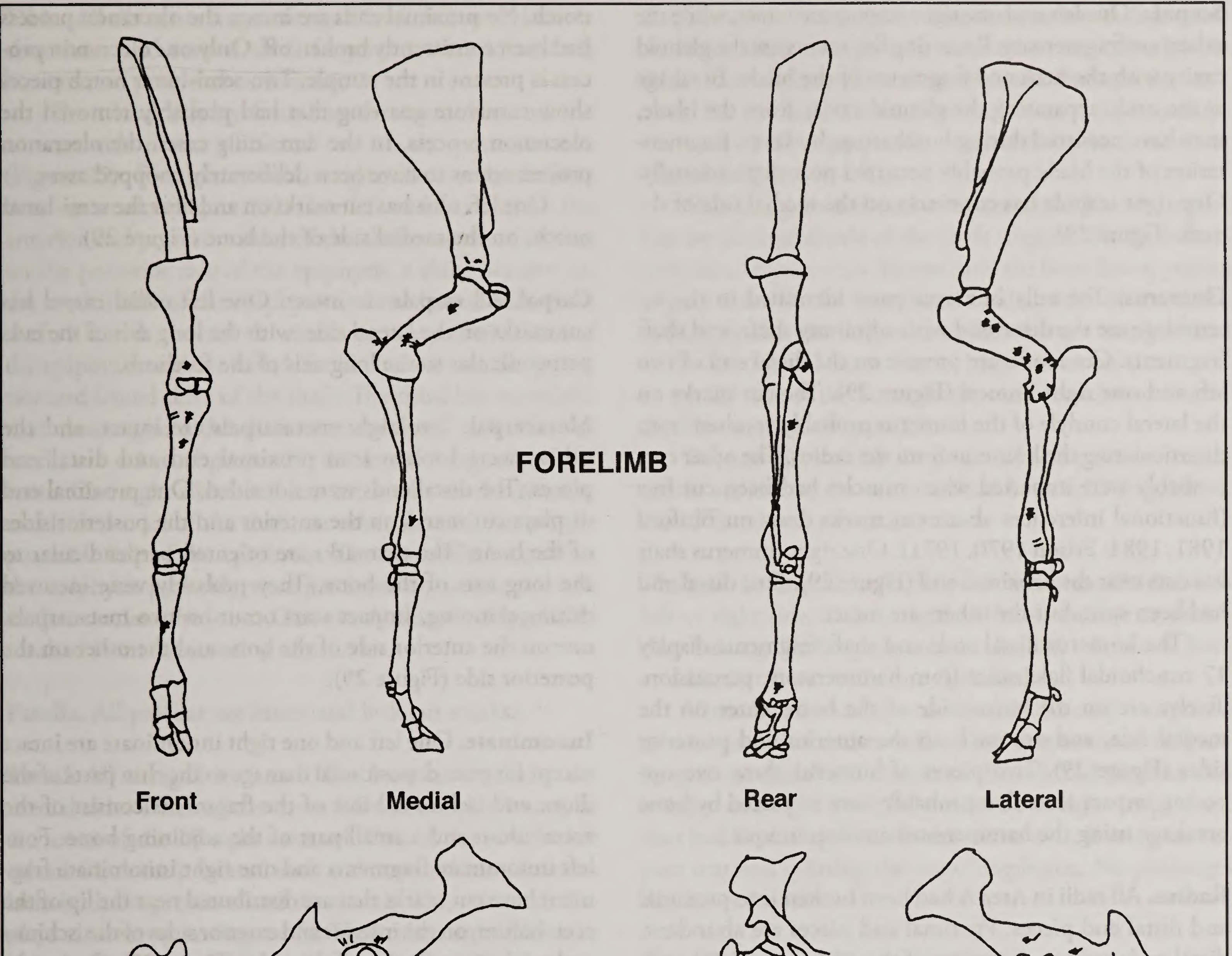



**Figure 29.** Location of cut marks (/) and impact scars (*) on forelimb and hindlimb bison bones from Area A (composite).

**Scapula.** One left and one right scapula are intact, while the others are fragmentary. Recurring fragments are the glenoid cavity with the neck and fragments of the blade. Breakage at the neck, separating the glenoid cavity from the blade, may have occurred during butchering; however, fragmentation of the blade probably occurred post-depositionally. One right scapula has cut marks on the medial side of the neck (Figure 29).

**Humerus.** The only humerus parts identified in the assemblage are the distal end with adjoining shaft, and shaft fragments. Cut marks are present on the distal end of two left and one right humeri (Figure 29). The cut marks on the lateral condyle of the humerus probably resulted from disarticulating the humerus from the radius. The other cuts probably were imparted when muscles had been cut free (functional inferences about cut marks draw on Binford 1981, 1984; Frison 1970, 1971). One right humerus shaft has cuts near the proximal end (Figure 29). One distal end had been split, but the others are intact.

The humerus distal ends and shaft fragments display 17 conchoidal flake scars from hammerstone percussion. Twelve are on the lateral side of the bone, three on the medial side, and one each on the anterior and posterior sides (Figure 29). Two pieces of humerus show two opposing impact scars that probably were imparted by bone breakage using the hammer-and-anvil technique.

**Radius.** All radii in Area A had been broken into proximal and distal end pieces. Proximal end pieces are abundant, distal ends are not. Fourteen of the 16 left proximal ends are intact, as are 11 of the 14 rights. The others had been split lengthwise. Five of the seven distal ends of the left radii are intact, as are all six distal ends of the right side.

Two proximal ends of left radii display cut marks. The cuts occur on the anterior side of one and on the anterior and medial side of the other (Figure 29). One distal end of a radius has cut marks on the lateral side of the shaft (Figure 29). The cuts on the anterior side of the proximal end had probably been made to disarticulate the radius from the humerus, and the other cuts had probably been imparted when the muscles were cut free.

Six proximal ends of radii have impact scars. Five of the impact scars are located on the anterior side of the shaft and the other is on the posterior side of the shaft (Figure 29).

**Ulna.** All ulnae are fragmentary, consisting of the semilunar notch and adjacent area of articulation with the proximal end of the radius and, less commonly, fragments of the area of articulation with the radius without the semi-lunar notch. No proximal ends are intact; the olecranon process had been consistently broken off. Only one olecranon process is present in the sample. Two semi-lunar notch pieces show carnivore gnawing that had probably removed the olecranon process. In the remaining cases, the olecranon process seems to have been deliberately chopped away.

One left ulna has cut marks on and near the semi-lunar notch, on the medial side of the bone (Figure 29).

**Carpal.** All carpals are intact. One left radial carpal has cut marks on the lateral side, with the long axis of the cuts perpendicular to the long axis of the forelimb.

**Metacarpal.** Two right metacarpals are intact, and the others were broken into proximal end and distal end pieces. The distal ends were not sided. One proximal end displays cut marks on the anterior and the posterior sides of the bone. The cutmarks are oriented perpendicular to the long axis of the bone. They probably were incurred during skinning. Impact scars occur on two metacarpals, one on the anterior side of the bone and the other on the posterior side (Figure 29).

**Innominate.** One left and one right innominate are intact except for post-depositional damage to the thin parts of the ilium and ischium. Most of the fragments consist of the acetabulum and a small part of the adjoining bone. Four left innominate fragments and one right innominate fragment have cut marks that are distributed near the lip of the acetabulum, on the interior and exterior sides of the ischium and on the interior side of the pubis (Figure 29). Cut marks near the lip of the acetabulum had probably been imparted when the femur was disarticulated. The other cuts may have been produced when muscles were cut free.

Whether the innominates had been broken during butchering and processing or post-depositionally could not be determined.

**Femur.** The relatively few femora are all fragmentary. Both the proximal and distal ends are represented, as is the shaft. All of the proximal end pieces and distal end pieces are fragmentary.

The one right distal end fragment has cut marks on both the anterior and posterior sides of the diaphysis (Figure 29). One of the proximal end pieces has three closely spaced impact scars on the anterior side of the shaft (Figure 29). The greater trochanter of this bone had been broken off. One right femur shaft has two closely spaced impact scars on the lateral side near the distal end, and one distal end fragment has an impact scar on the lateral side (Figure 29).

**Tibia.** All tibiae are fragmentary. Distal ends are relatively abundant, and several shaft fragments were identified; however, no proximal ends occur.

The tibiae display four impact scars, three on the anterior side of the tibia and one on the posterior side (Figure 29). Five left and three right distal ends of tibiae bear cut marks (Figure 29). One left end has cuts on the anterior and posterior sides of the shaft, another has cuts on the posterior side of the epiphysis, a third has cuts on the medial side of the epiphysis and the lateral side of the shaft, a fourth showed cut marks on the posterior side of the epiphysis, and the fifth left tibia has cuts on the posterior and lateral sides of the shaft. The third has cut marks that almost girdle the shaft near the distal end - the cut marks are oriented perpendicular to the long axis of the bone. One right distal end has cut marks on the anterior and lateral sides of the shaft, an other showed cuts on the posterior side of the epiphysis. The cut marks located on the epiphysis probably were produced by incisions made to disarticulate the joint. Cuts on the diaphysis probably resulted from the severing of muscles.

**Patella.** All patellae are intact and lack cut marks.

**Tarsal.** All astragali are intact. Two have cut marks on the medial side. Three of the seven left calcanei are intact, as are seven of the 10 right calcanei. Two of the broken left calcanei lack the proximal end, and the third left calcaneus lacks both the proximal and distal ends. This calcaneus displays carnivore-gnawing marks. The broken right calcaneus lacks both the proximal and distal ends. One left calcaneus has cut marks on the lateral side (Figure 29).

All naviculocuboids are intact, and none show cut marks. The other tarsal bones are intact. Two lateral malleoli have cut marks on their lateral side.

**Metatarsal.** All but one metatarsal had been broken, separating the proximal end from the distal end. The distal end pieces of metatarsals were not sided during analysis. Three left proximal end pieces have cut marks; on two, the cuts occur on the anterior side of the diaphysis, while cuts occur on the posterior side of the diaphysis on the third (Figure 29). Two right proximal end pieces have cut marks, one on the lateral side of the diaphysis and the other on the posterior side of the diaphysis (Figure 29). Four distal end pieces show cut marks: three have cuts on the anterior side of the diaphysis and one on the lateral or medial side of the diaphysis (Figure 29). None of the cut marks on the metatarsals occur at the proximal or distal extremities of the bone where the metatarsal articulates with tarsal bones and phalanges, respectively; thus, disarticulation of the joints did not cause the observed cut marks. It is more likely that the cut marks were made when the animals were skinned or when tendons were removed. Perhaps, in some cases, the marks had been imparted when the periosteum was scraped off in preparation for cracking the bone open (Binford 1978:153-155).

One left proximal end of a metatarsal has an impact scar on the lateral side of the shaft (Figure 29). Two distal ends have impact scars. In one case, the bone has opposing impact scars on the lateral and medial sides of the shaft, indicating that the bone was broken using a hammer and anvil. The second bone has an impact scar on the lateral or medial side of the bone, in the same location as that of the first example (Figure 29).

Twenty-three of the 29 proximal end pieces of metatarsals are intact; the other six had been split lengthwise. All 13 distal end pieces are intact.

**Phalanx.** In this analysis, the phalanges were divided into left or right side, indicating the side of the foot to which they belong. Phalanges were not divided relative to fore- and hindlimb nor by left or right limb.

Virtually all phalanges are intact. The only exceptions are one proximal and two distal end fragments of 1st phalanges, one distal end fragment of a left 2nd phalanx and another of a right 2nd phalanx, and one right 1st phalanx that had been impacted on the dorsal side, leaving an impact scar and splitting the bone lengthwise. No phalanges display cut marks.

**Bone Fragments.** The unidentifiable bone fragments from a site are potentially useful indicators of certain aspects of carcass utilization. Unfortunately, the long bone shaft fragments from the site had undergone considerable post-depositional breakage, inflicted during their extraction from dry clay and perhaps during subsequent transport, and it was impossible to estimate accurately the number of shaft fragments present prior to post-depositional breakage. A total of 1,976 long bone shaft fragments, unidentifiable as to element, are present in the assemblage from Area A. Of that total, 1,576 are small pieces that have recently broken edges. The other 400 pieces are relatively large, and they do not show recent breakage.

An additional 1,076 bone fragments are unidentifiable as to skeletal part. Many of these fragments show recent breakage; this count also inflates considerably the number of bone fragments originally deposited.

**Carnivore-Gnawed Bones.** Twenty-two bones and bone fragments from Area A show indications of gnawing by carnivores (Table 19). These bones have punctures, furrowing,

or scoring marks similar or identical to those noted on modern carnivore-gnawed bones and to descriptions of modern carnivore-gnawed bones (e.g., Binford 1981; Fisher 1995).

It is possible that scavenging by carnivores had altered, to some extent, the composition of the Area A bone assemblage. Carnivores can chew and swallow small bones or parts of larger bones and they can rearrange the spatial distribution of bones or even carry bones away from a site. The precise impact of carnivore scavenging on the Area A bone assemblage is difficult to assess. The fairly low number of carnivore-damaged bones in the Stark site Area A and Area B assemblages seems to indicate little scavenger depredation. However, since scavenging carnivores sometimes carry bones away from a carcass (e.g., Haynes 1982:268,277), that type of attrition might be difficult to recognize.

In attempting to ascertain the extent of scavenger attrition to the bone assemblage, it is instructive to mention that modern wolves prefer to eat fresh meat from their own kills rather than meat from animals they did not kill, and that they do less damage to scavenged carcasses than to their own kills (Haynes 1980:76,94, 1982:268; Stenlund 1955:21). Stenlund observed that, "Generally wolves eat little carrion. They prefer fresh meat and prefer to kill it themselves." Thus, we cannot assume a priori that abandoned bison carcasses at Stark (or other bison kill sites) attracted scavenging wolves.

Other carnivores, such as bears and coyotes, scavenge readily. However, various ecological factors would have influenced the scavenging behavior of local wild carnivores: the season of the kill, the availability of game and other food, and the density of carnivore populations. Such interrelationships must be studied using evidence from prehistoric bone assemblages and observations made in modern ecosystems where bison, their predators, and other carnivores survive.

**Table 19.** Area A Bison and Canid Bones Gnawed by Carnivores.

| Element | Comments |
|---|---|
| **Bison** | |
| left ulna-prox. end | olecranon gnawed away |
| left humerus | distal end of diaphysis chewed (epiphysis missing, probably unfused) |
| right ulna-prox. end | olecranon gnawed off |
| metatarsal | marks on diaphysis |
| metatarsal | furrows on prox. articular surface and adjacent shaft |
| left innominate | marks near acetabulum |
| left metacarpal | marks near prox. end |
| left calcaneus | tuber calcis gnawed off |
| innominate | furrows on pubic symphysis |
| left metatarsal | marks near top of shaft |
| metalarsal | distal end of diaphysis gnawed |
| left humerus | distal end gnawed |
| right 2nd phalanx | pitted |
| right calcaneus | shaft furrowed |
| left ulna-prox. end | olecranon gnawed off |
| left humerus | furrowed |
| metacarpal shaft | furrowed |
| thoracic vertebra | tooth punctures |
| left radius-prox. end | furrows on shaft |
| **Canid** | |
| 2nd phalanx | surface was eroded, perhaps had passed through digestive tract |
| **Fetal Bison** | |
| long bone shaft fragment | furrows on diaphysis: cut marks or gnawing |
| humerus diaphysis | furrows on shaft |

## Discussion

Interpretation of the Stark site skeletal assemblages will benefit by a brief modeling of the possible sequence of steps involved in carcass use, which distinguishes three main activities: (1) killing and initial butchering (skinning and dismembering into primary butchering units); (2) processing the carcass for meat, marrow, and bone grease; and (3) consumption of the food products (see Wheat 1972:98-103, 1978; Binford 1978; Frison 1978:148, 1991:298-325). The location of the respective activities relative to each other will affect the resulting bone assemblages. Four reasonable permutations of activity at such locations can be envisioned: (1) all three activities (kill/initial butchering, processing, and consumption) took place at one location; (2) each of these three activities occurred in a separate location; (3) killing/initial butchering and processing were accomplished in one spot, while the food products were consumed elsewhere; and (4) killing/initial butchering was done in one spot and processing and consumption took place together at another location. At each step in the sequence of carcass use, certain anatomical parts might have been abandoned.

Three additional factors add complexity to this model. First, meat, marrow, and/or internal organs may have been consumed during butchering and processing; second,

bone-processing might have been accomplished at both the processing area and at a separate consumption (residential) site; and third, meat-processing might have included preservation by drying or chilling cuts of meat with bones still attached (see Binford 1978:94-101). Subsequently, these preserved parts could have been consumed in an entirely different area, resulting in further dispersal of bones.

The manner in which carcasses are butchered and utilized might have been influenced by various logistical, demographic, climatic, and social factors. Some of the more direct influences would include the number of animals killed, the size of the human group to be sustained, the time of year and weather conditions, and the distance from the kill site to the campsite. A variety of indirect factors also can affect decisions regarding carcass use (e.g., Bartram 1993; Binford 1978; Bunn 1993; Bunn et al. 1988; Frison 1974:26-27, 1978:302-305; O'Connell 1995; O'Connell et al. 1988; Speth 1983). For the Area A assemblage, the kill event or events were probably carried out in the fall and/or winter and perhaps into the spring. Other factors that might have importantly influenced the manner of carcass use, such as the size of the human group and various logistical considerations, remain as intangibles to be considered.

The relative food value of carcass parts is an important determinant in reconstructing the manner of carcass utilization, and it is useful to bear in mind the relative economic value of the different carcass parts when interpreting a bone assemblage. Certain skeletal parts have a high ratio of bone to meat, and there is little incentive to transport them from the kill site. The cranium, which is heavy and has little meat, is one of those elements (e.g., Binford 1978; Metcalf and Jones 1988; Wheat 1978). Foot bones (metapodials, carpals, tarsals, and phalanges) also lack meat. Upper leg bones (humerus and femur) carry large muscle masses, and lower leg bones (radius/ulna and tibia) and ribs and vertebrae also carry muscles.

The grease content of bone is another factor that might have influenced the manner of carcass use. Brink's (1997: Table 3) values for mean fat weight in bones of bison reveals that the proximal ends of the humerus, radius, tibia, and femur and the distal end of the femur rate highest. Bones with a lower rating include the (olc) proximal and distal ends of metapodials, and the distal ends of the humerus, radius, and tibia (see also Binford 1978:Table 1.11).

The Food Utility Index (FUI) (Metcalfe and Jones 1988) ranks skeletal parts based on the amount of associated meat, marrow, and bone grease. Although the FUI (Table 20) is based on caribou, it probably is broadly applicable to bison. The proximal and distal ends of the femur rank highest. These are followed by the sternum, proximal end of the tibia, ribs, pelvis, thoracic vertebrae, proximal end of the humerus, scapula, and distal end of the tibia. The lowest ranked skeletal parts include the cranium, metatarsals, phalanges, and dentaries. Given the much larger size of bison compared to caribou, it is possible that thoracic vertebrae and the pelvis might not have ranked as high to bison hunters. In addition, given the massiveness of bison forequarters, the upper forelimb elements are perhaps somewhat undervalued by the FUI.

Wheat (1972:102-103), by surveying ethnohistoric accounts of Plains Indian butchery of bison, derived generalizations useful for understanding and interpreting bison bone assemblages: crania and dentaries usually remained at the kill site; the vertebral column and innominates sometimes had been abandoned at the kill and, on other occasions, were taken to the camp; rib slabs had been broken free from the vertebrae, but sometimes the meat had been removed from the ribs at the kill site and the bones abandoned; the bones of the forelimb, including the scapula, often remained at the kill; the long bones from the hindleg were preferred for marrow over those of the foreleg; and, while the feet (metapodials and phalanges) had little food value, they could be used as tools or processed for glue. These generalizations must be applied cautiously because they were derived from the behavior of people who had horses available for transportation. Wheat's generalizations do not control explicitly for factors affecting carcass use patterns, such as the size of the human group, the number of bison killed, the distance between the kill and the occupation site, and so forth.

On the basis of the foregoing discussion, we propose a rough model for the bone assemblage at kill, processing, and residential areas at the Stark bison kill site. Such modelling may be of value for interpreting these particular assemblages, recognizing that variability is to be expected from one site to the next as a result of the often unique interplay of controlling situational and local factors. The operational use here of relative terms such as "abundant," "common," and "rare" is recognized as imprecise and less than satisfactory.

## Kill/Initial Butchering Area

Crania, dentaries, and foot bones will be abundant. Vertebrae and ribs may be common, or they may be rather scarce. Leg bones will be relatively rare, the hindlimb bones more so than those of the forelimb. However, Wheat (1978:88) proposed that foot bones may remain attached to fore- and hindquarters carried away from the kill area. Relatively few long bones will be broken.

## Processing Area

Crania, dentaries, and probably foot bones will be relatively uncommon. Vertebrae and ribs will vary from common to rare, and, if present, vertebrae probably will have been processed for grease. Long bones will have been processed for marrow and perhaps for grease. Hindleg bones will be more common than foreleg bones.

## Residential Area

Crania, dentaries, and foot bones will be rare. Vertebrae and ribs may be common or rare. Long bones will be uncommon or rare, and those present will have been processed for grease and marrow.

Kill/initial butchering areas and processing areas may sometimes be difficult to distinguish from each other on the basis of the faunal assemblage alone, given the range of possible variability in bone assemblages.

The Area A assemblage shows a great deal of variability in the frequency of skeletal parts. Figure 30 illustrates the relative frequency of skeletal parts; the values were drawn from Table 17, using for paired elements the highest of the two values. The dentary and cranium values were derived from tooth counts not presented in Table 17.

The most common bones in Area A are the radius, especially the proximal end, the distal end of the tibia, and the metatarsals (in particular the proximal end) the proximal end of the metacarpal, and the naviculocuboid. Most of these bones rate relatively poorly both in their grease content and with regard to the amount of meat attached.

Bones that occur in intermediate frequency at the site include crania and dentaries, distal ends of humerus and radius, innominate, astragalus, calcaneus, distal end of metatarsal, and phalanges. Most of these bones also rate relatively poorly with regard to food utility. The low frequency of phalanges and the distal end of the metapodials is problematical, given the low economic value of these parts and the abundance of proximal ends of metapodials.

Vertebrae, ribs, proximal end of the humerus, femur, and proximal end of the tibia are rare or absent from Area A. These rank among the highest food utility elements. Ribs might have been carried elsewhere for consumption or processing, perhaps in articulated units. The absence of the proximal end of the humerus, the femur, and the proximal end of the tibia is predictable, given the large quantity of easily processed grease. Many humeri and femora might have been taken from the site for processing elsewhere.

The rather low frequency of scapulae suggests that this bone had often been carried away from the kill site, perhaps attached to the humerus. The scapula alone has little economic utility except for some musculature, but the upper forelimb may have been a convenient butchering unit. The scapulae that remained at the site seem to have

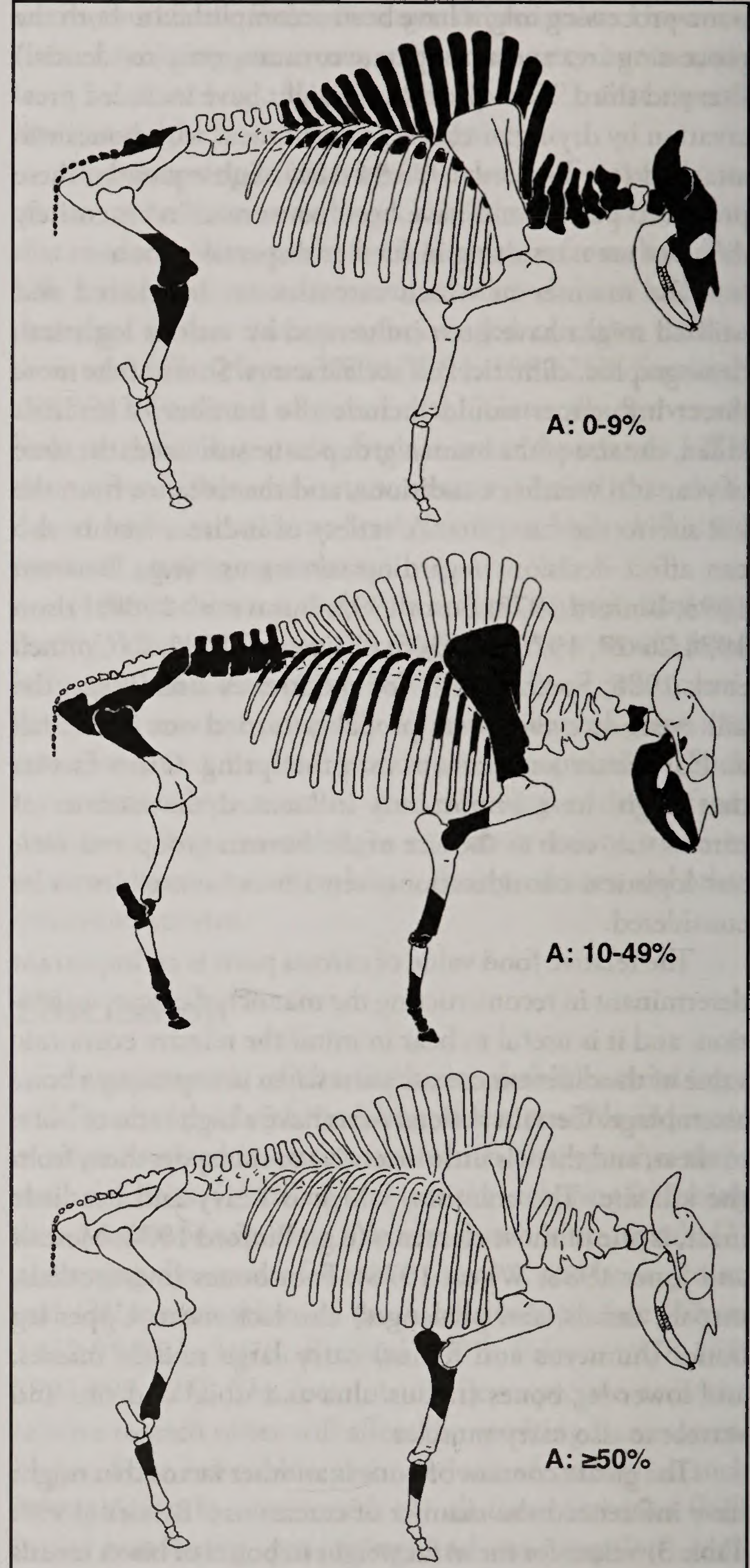



**Figure 30.** Diagram of a bison skeleton showing the relative frequency of skeletal parts (Table 17, column 3) in Area A (Top: bones shaded black have a frequency of 0-9%; middle: bones shaded black have a frequency of 10 to 49%; bottom: bones shaded black have a frequency equal to or greater than 50%).

been detached from the humerus by dissecting through the muscles and ligaments in some cases and by chopping through the scapula neck at other times.

Many of the radii were detached from humeri and abandoned at Stark, as is indicated by the large number of proximal ends of the radius. The intact condition of the distal end pieces of the humerus and the proximal end pieces of the radius indicate that disarticulation was accomplished by cutting rather than chopping. Cut marks at this joint on a humerus and a radius reinforce this supposition. On one ulna, the olecranon process seems to have been deliberately chopped off, for which muscle removal (Frison 1978:314) would have been the most likely purpose. Cut marks on one ulna attest to joint disarticulation by bisection.

Femora were detached from the innominate by cutting, and perhaps occasionally by chopping.

Cut marks on the distal end of some tibiae and on some tarsal bones are evidence that the ankle joint had occasionally been dismembered. Proximal ends of metatarsals remained at the site in large numbers.

Few long bones in Area A are intact. The shaft was probably split to remove the marrow and, in some cases, to detach low-value parts from desired limb units (e.g., by chopping off distal ends of humeri and tibiae).

The technique used to break open long bones, and the location of the associated blows, are potentially useful for interpretation. For example, the social context or activity context in which bones were split open for marrow may be reflected in (1) whether the bone was broken with a hammer-and-anvil or with just a hammer and (2) the part of the bone that was impacted (Binford 1981:150,166). The location of blows on bones can be identified by resultant impact scars (see Binford 1981:155,157,160; Bonnichsen and Will 1980:11; Fisher 1995), and breakage of bone using a hammer-and-anvil sometimes can be identified by the presence of opposing impact scars.

The sample of impact scars from Area A is too small to allow the confident interpretation of patterned bone breakage. However, it is apparent that most of the impact scars on humeri are located on the lateral and medial sides of the bone. Tibiae show impact scars on the anterior and posterior sides, while radii display them on all four sides (Figure 30).

Bone grease manufacture involved pulverizing bones, especially the grease-rich articular ends, such as the proximal ends of the humerus and tibia, and boiling of the fragments to render the grease. Ethnographic descriptions emphasize the large quantity of small bone fragments produced by this activity (cf. Binford 1978:157-159 and Leechman 1951). Although the Area A assemblage contained many bone fragments of both long bone shafts and of unidentified skeletal parts, much of this fragmentation is exaggerated by post-depositional and recent breakage. The bone fragments do not seem to have been intensively pulverized to the extent apparent in other archaeological sites where bone grease production was carried out. However, it is possible that decomposition could have eliminated much of such bone debris.

Several indices that measure the food utility of carcass parts have been developed by archaeologists in recent years. All of them rate skeletal elements (complete bones or, more commonly, subdivision of bones) by their food value based on the yield of meat, marrow, and/or bone grease associated with a given skeletal element. These indices can be compared to frequencies of skeletal elements in an archaeological bone assemblage, to assess whether the element frequencies in the archaeofauna result from human activities aimed at efficient exploitation of carcasses.

In recognition that processes other than carcass use by humans can potentially influence skeletal part frequencies, an index of bone density of bison skeletal parts has been developed (Kreutzer 1992; see also Lyman 1984). Comparisons between bone density and element frequencies in an archaeofauna can test for the actions of density-mediated bone destruction as a factor in bone assemblage formation. (Such factors would include weathering, mechanical breakage of bones by human or non-human processes, and so forth.)

Comparisons between bison skeletal element frequencies from Areas A and B were carried out with the following indices: (a) Food Utility Index (FUI) (Metcalfe and Jones 1988); (b) Complete Bone Food Utility Index (CFUI) (Metcalfe and Jones 1988); (c) Bone Grease Weight (BGW) (Brink 1997: Table 3, column for Mean Fat Weight); and (d) Bone Density (Kreutzer 1992). Skeletal element frequencies for Areas A and B for the Stark bison archaeofauna are represented by Minimum Animal Units (MAU) (Table 20).

Comparisons between Stark Area A and Area B archaeofaunas and the various indices were made by rank order correlation, using the Spearman's rho statistic to determine the correlation coefficient and significance.

The Bone Grease Weight index is a measure of the amount of bone grease contained *within* bone tissue. In prehistoric times, bone grease could have been extracted from bones by breaking an smashing the bones, boiling the broken bones, and skimming the grease from the surface of the water. The BGW index was created using bison bones.

The Food Utility Index, as discussed earlier, reflects the amount of meat, marrow, and bone grease associated with different body parts (it was developed from caribou).

**Table 20.** Skeletal Element Frequencies (Minimum Animal Units) for the Archaeofauna and Various Bone Utility Indices.

| Element | MAU-A[1] | MAU-B[2] | Density[3] | FUI[4] | CFUI[5] | BGW[6] |
|---|---|---|---|---|---|---|
| Dentary | 7 | 3.5 | .53 | 590 | 590 | -1[7] |
| Atlas | 3 | 2 | .52 | 524 | 524 | -1 |
| Axis | 0 | 0 | .65 | 524 | 524 | -1 |
| Cervical | 1.2 | 1.2 | .37 | -1 | 1,905 | -1 |
| Thoracic | .9 | 1.7 | .42 | 2,433 | 2,433 | -1 |
| Lumbar | 1.2 | 1 | .31 | 1,706 | 1,706 | -1 |
| Sacrum | 0 | 2 | .27 | -1 | -1 | -1 |
| Rib | 1.2 | 2.1 | .57 | 2,650 | 2,650 | -1 |
| Sternum | -1 | -1 | -.1 | 3,422 | 3,422 | -1 |
| Scapula | 5.5 | 4 | .50 | 2,295 | 2,295 | -1 |
| Prox. Hum. | 0 | 0 | .24 | 2,295 | 2,295 | 324.28 |
| Dist. Hum. | 6.5 | 0 | .38 | 1,891 | -1 | 77.28 |
| Prox. Rad. | 15 | 4.5 | .48 | 1,323 | -1 | 115.98 |
| Dist. Rad. | 6.5 | 3 | .35 | 1,039 | 1,323 | 71.26 |
| Carpal 2&3 | 3 | 4.5 | .50 | -1 | -1 | -1 |
| Carpal Radial | 6.5 | 4 | .42 | -1 | -1 | -1 |
| Carpal Ulnar | 9 | 3 | .43 | -1 | -1 | -1 |
| Carpal 4 | 6 | 3 | .44 | -1 | -1 | -1 |
| Prox. Metacarpal | 11 | 7.5 | .59 | 461 | -1 | 7.14 |
| Dist. Metacarpal | 5 | 5.5 | .53 | 364 | 795 | 25.97 |
| Prox. 1st phal. | 3 | 10.6 | .48 | -1 | -1 | -1 |
| Dist. 1st phal. | 3 | 10.8 | .48 | -1 | -1 | -1 |
| Complete 1st phal. | 2.9 | 10.6 | -.1 | 443 | 998 | -1 |
| Prox. 2nd phal. | 1.8 | 8.4 | .41 | -1 | -1 | -1 |
| Complete 2nd phal. | 1.8 | 8.4 | -.1 | 443 | -1 | -1 |
| 3rd phalanx | 3.5 | 6.6 | .32 | 443 | -1 | -1 |
| Innominate | 6 | 2 | .53 | 2,531 | 2,531 | -1 |
| Prox. Femur | 2.5 | 4.5 | .34 | 5,139 | 5,139 | 110.92 |
| Dist. Femur | .5 | 2 | .26 | 5,139 | -1 | 256.23 |
| Prox. Tibia | 0 | 1.5 | .41 | 3,225 | -1 | 128.92 |
| Dist. Tibia | 13 | 6 | .41 | 2,267 | -1 | 17.64 |
| Astragalus | 8 | 11.5 | .72 | 1,424 | -1 | -1 |
| Calcaneus | 8.5 | 16.5 | .80 | 1,424 | 3,225 | -1 |
| Naviculo-cuboid | 13.5 | 13.5 | .48 | -1 | -1 | -1 |
| Lateral Malleolus | 12 | 1.5 | .56 | -1 | -1 | -1 |
| Prox. Metatarsal | 15 | 12 | .52 | 1,003 | -1 | 8.74 |
| Dist. Metatarsal | 8.5 | 11 | .48 | 792 | 1,903 | 35.85 |

[1] Minimum Animal Units (MAU) for Stark site Area A assemblage.
[2] MAU for Stark site Area B assemblage.
[3] Bone Density (bone VD, Kreutzer 1992).
[4] Food Utility Index (Metcalfe and Jones 1988).
[5] Complete Bone Food Utility Index (Metcalfe and Jones 1988).
[6] Bone Grease Weight (Brink 1997:Table 3, column for Mean Fat Weight).
[7] -1 signifies absence of data.

The Bone Density Index scales different skeletal parts by their density. Density measurements were made on bison bones.

The Complete Bone Food Utility Index is calculated for complete bones, rather than for the proximal end and the distal end separately of long bones. It, too, is for caribou.

For Area A, the Bone Grease Weight Index and Bone Density Index have a statistically significant correlation with the bison skeletal element frequencies. Bone Grease Weight and MAU have a fairly strong, negative correlation (-.696) that is statistically significant at the .05 level (2-tailed). The higher the BGW value for skeletal elements, the lower their frequency in the Stark archaeofauna. Seventy percent of the variability in skeletal element frequencies can be explained by BGW. This relationship could be the result of selective transport of skeletal parts with high grease utility away from the Stark site (assuming that Stark is the kill site) to some other location for bone-processing to extract grease.

Bone Density also correlates significantly with the Area A MAU (.443; significant at the .01 level). Bone Density explains less of the variation in skeletal parts than BGW. This correlation does not specify a human or non-human agency, and either one or both of these agencies might have been responsible. Indeed, bones having lower density tend to have a higher BGW value, making less dense bones more attractive for grease processing (Brink 1997). They also would have been attractive to scavenging carnivores.

The lack of a statistically significant correlation between the Area A MAU and the FUI and CFUI implies that meat and marrow nutritional values for a given carcass part played a minor role (or none at all) in carcass use decisions.

## Area B Bison

Area B contained the remains of a minimum of 16 bison, based on counts of the left and right calcaneus (Table 21). No fetal bison bones were found in Area B.

Post-depositional weathering, cracking, and splitting of bones were severe in the Area B assemblage. The outer layer of bone had exfoliated from most of the elements in the assemblage. Although most bones are durable, post-depositional damage is common. Frequently, such breakage can be identified as post-depositional because of dry-bone breakage. It is difficult to differentiate between green-bone breakage and dry-bone breakage on cranial fragments, pieces of dentaries, some scapulae and innominates, and on some long bones. The more severe bone-weathering and cracking in Area B, compared to that in Area A, may be a function of slower burial by sediments in Area B and/or of the greater antiquity of that deposit.

As in Area A, more maxillae and dentaries are represented by isolated teeth than by bone parts, indicating that skulls had undergone some decomposition. It is possible that decomposition had altered the frequency of other skeletal parts, although most of the bones are durable.

Evidence for scavenging by carnivores in Area B is discussed in more detail below.

**Table 21.** Frequency of Area B Bison Skeletal Elements.

| Element | Side | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Cranium: | | | | | |
| maxilla | L | 0 | 0 | 0 | .5 |
| | R | 0 | 0 | 0 | |
| | U | 1 | .5 | 2.9 | |
| premaxilla | L | 2 | 2 | 11.8 | 2.5 |
| | R | 3 | 3 | 17.6 | |
| orbit | L | 1 | 1 | 5.9 | 1 |
| | R | 0 | 0 | 0 | |
| | U | 1 | .5 | 2.9 | |
| occipital condyle | U | 1 | .5 | 2.9 | .5 |
| Mandible: | | | | | |
| asc. ramus | L | 1 | 1 | 5.9 | 2 |
| | R | 3 | 3 | 17.6 | |
| incisor end | L | 2 | 2 | 11.8 | 3.5 |
| | R | 3 | 3 | 17.6 | |
| | U | 2 | 2 | 11.8 | |
| Hyoid | L | 1 | 1 | 5.9 | 3.5 |
| | R | 1 | 1 | 5.9 | |
| | U | 5 | 2.5 | 14.7 | |
| Vertebrae: | | | | | |
| Atlas | | 2 | 2 | 11.8 | 2 |
| Axis | | 0 | 0 | 0 | 0 |
| Cervical 3-7 | | 6 | 1 | 5.9 | 1.2 |
| Thoracic | | 24 | 1.7 | 10 | 1.7 |
| Lumbar | | 5 | 1 | 5.9 | 1 |
| Sacrum | | 2 | 2 | 11.8 | 2 |
| Caudal vertebra | | 14 | .9 | 5.3 | .9 |
| Ribs: | | | | | |
| vertebral end | | 60 | 2.1 | 12.4 | 2.1 |
| sternal end | | 2 | .07 | .4 | .07 |
| Scapula: | | | | | |
| complete | L | 1 | 1 | 5.9 | .5 |
| | R | 0 | 0 | 0 | |

| | | | | | |
|---|---|---|---|---|---|
| glenoid | L | 5 | 5 | 29.4 | 3.5 |
| | R | 2 | 2 | 11.8 | |
| blade | L | 3 | 3 | 17.6 | 3.5 |
| | R | 1 | 1 | 5.9 | |
| | U | 3 | 1.5 | 8.8 | |
| **Humerus:** | | | | | |
| shaft | L | 0 | 0 | 0 | 0 |
| complete | R | 0 | 0 | 0 | 0 |
| proximal | L | 0 | 0 | 0 | 0 |
| | R | 0 | 0 | 0 | |
| distal | L | 0 | 0 | 0 | 0 |
| | R | 0 | 0 | 0 | |
| shaft | L | 0 | 0 | 0 | 1 |
| | R | 0 | 0 | 0 | |
| | U | 2 | 1 | 5.9 | |
| **Radius:** | | | | | |
| complete | L | 1 | 1 | 5.9 | 1 |
| | R | 1 | 1 | 5.9 | |
| proximal | L | 6 | 6 | 35.3 | 3.5 |
| | R | 1 | 1 | 5.9 | |
| distal | L | 3 | 3 | 17.6 | 2 |
| | R | 1 | 1 | 5.9 | |
| Ulna-proximal | L | 6 | 6 | 35.3 | 5 |
| | R | 4 | 4 | 23.5 | |
| **Carpals:** | | | | | |
| intermediate | L | 7 | 7 | 41.2 | 5.5 |
| | R | 4 | 4 | 23.5 | |
| radial | L | 6 | 6 | 35.3 | 4 |
| | R | 2 | 2 | 11.8 | |
| ulnar | L | 5 | 5 | 29.4 | 3 |
| | R | 1 | 1 | 5.9 | |
| 2+3 | L | 4 | 4 | 23.5 | 4.5 |
| | R | 5 | 5 | 29.4 | |
| 4th | L | 3 | 3 | 17.6 | 3 |
| | R | 3 | 3 | 17.6 | |
| Accessory | U | 2 | 1 | 5.9 | 1 |
| **Metacarpal:** | | | | | |
| complete | L | 3 | 3 | 17.6 | 4 |
| | R | 5 | 5 | 29.4 | |
| proximal | L | 2 | 2 | 11.8 | 3.5 |
| | R | 5 | 5 | 29.4 | |
| distal | L | 0 | 0 | 0 | 1.5 |
| | R | 0 | 0 | 0 | |

| | | | | | |
|---|---|---|---|---|---|
| | U | 3 | 1.5 | 8.8 | |
| shaft | L | 0 | 0 | 0 | 1 |
| | R | 0 | 0 | 0 | |
| | U | 2 | 1 | 5.9 | |
| **Innominate:** | | | | | |
| | L | 3 | 3 | 17.6 | 2 |
| | R | 1 | 1 | 5.9 | |
| **Femur:** | | | | | |
| proximal | L | 3 | 3 | 17.6 | 4.5 |
| | R | 3 | 3 | 17.6 | |
| | U | 3 | 1.5 | 8.8 | |
| distal | L | 0 | 0 | 0 | 2 |
| | R | 3 | 3 | 17.6 | |
| | U | 1 | .5 | 2.9 | |
| shaft | L | 3 | 3 | 17.6 | 1.5 |
| | R | 0 | 0 | 0 | |
| **Tibia:** | | | | | |
| proximal | L | 2 | 2 | 11.8 | 1.5 |
| | R | 1 | 1 | 5.9 | |
| distal | L | 5 | 5 | 29.4 | 6 |
| | R | 7 | 7 | 41.2 | |
| shaft | L | 2 | 2 | 11.8 | 4 |
| | R | 1 | 1 | 5.9 | |
| | U | 5 | 2.5 | 14.7 | |
| **Patella:** | | | | | |
| | L | 4 | 4 | 23.5 | 3 |
| | R | 2 | 2 | 11.8 | |
| **Tarsals:** | | | | | |
| astragalus | L | 10 | 10 | 58.8 | 11.5 |
| | R | 13 | 13 | 76.5 | |
| calcaneus | L | 16 | 16 | 94.1 | 16.5 |
| | R | 16 | 16 | 94.1 | |
| | U | 1 | .5 | 5.9 | |
| naviculo-cuboid | L | 14 | 14 | 82.4 | 13.5 |
| | R | 13 | 13 | 76.5 | |
| tarsal 2+3 | L | 8 | 8 | 47.1 | 7.5 |
| | R | 7 | 7 | 41.2 | |
| Lateral malleolus | L | 2 | 2 | 11.8 | 1.5 |
| | R | 1 | 1 | 5.9 | |
| **Metatarsal:** | | | | | |
| complete | L | 5 | 5 | 29.4 | 4.5 |
| | R | 4 | 4 | 23.5 | |

| | | | | | |
|---|---|---|---|---|---|
| proximal | L | 9 | 9 | 52.9 | 7.5 |
| | R | 6 | 6 | 35.3 | |
| distal | L | 0 | 0 | 0 | 6.5 |
| | R | 0 | 0 | 0 | |
| | U | 13 | 6.5 | 38.2 | |
| shaft | L | 0 | 0 | 0 | .5 |
| | R | 0 | 0 | 0 | |
| | U | 1 | .5 | 2.9 | |
| 1st Phalanx (fore&hind): | | | | | |
| complete | L | 46 | 11.5 | 67.6 | 10.6 |
| | R | 39 | 9.8 | 57.6 | |
| distal | U | 1 | .1 | .6 | .1 |
| 2nd Phalanx (fore&hind): | | | | | |
| complete | L | 32 | 8 | 47.1 | 8.4 |
| | R | 35 | 8.8 | 51.8 | |
| distal | U | 1 | .1 | .6 | .1 |
| 3rd Phalanx (fore&hind): | | | | | |
| | L | 31 | 7.8 | 45.9 | 6.6 |
| | R | 22 | 5.5 | 32.4 | |
| Sesamoid: | | | | | |
| distal | | 19 | 2.4 | 14.1 | 2.4 |
| proximal | | 29 | 1.8 | 10.6 | 1.8 |
| | | | | | |

1 = minimum number of elements (MNE).
2 = minimum number of individuals (MNI).
3 = percent of MNI (17).
4 = minimum animal units (MAU).

## Description of Skeletal Parts, Area B

**Cranium.** Since all skulls are fragmentary, it is difficult to estimate accurately the number of skulls represented. Only three skulls are represented by premaxillae. Teeth gave a count of about 40 percent of the MNI of 16.

Cranial parts identified include the maxilla, premaxilla, orbit border, and occipital condyle. Because of the considerable post-depositional breakage of cranial parts, it cannot be known whether skulls had been broken open during butchering and processing.

**Dentary.** All dentaries in Area B are broken. Recurring dentary parts are the ascending ramus, the horizontal ramus at the cheek teeth, and the diastema and incisor teeth. Few teeth were recovered in their socket; most occurred as isolated fragments. The condition of the bone prohibited distinguishing between breakage caused by butchering/processing and breakage caused by post-depositional processes such as excavation.

Cut marks are present at the diastema of one dentary on the ventral border, and on the lateral side just below the mental foramen (Figure 31). About 44 percent of MNI is represented by teeth.

**Hyoid.** One left and one right hyoid occur in the assemblage, along with five fragments that could not be identified to side: none show cut marks.

**Vertebra.** One atlas vertebra is intact, as are two cervical 3-7 vertebrae and one thoracic vertebra. The remaining vertebrae are fragmentary (except for the caudal vertebrae). Whether butchering, post-depositional breakage, or a combination of these factors were responsible could not be determined. The vertebrae lack cut marks.

Two fragmentary sacra are present in the sample.

**Rib.** All ribs had been broken. There are 60 vertebral ends of ribs and two sternal ends. Mid-shaft fragments number 1,344, 1,216 of which are small, recently broken fragments. Post-depositional breakage was severe, and the actual number of rib midshaft fragments prior to breakage undoubtedly number less than one-third of the 1,344 fragments not present.

**Scapula.** One left scapula is intact, while the remaining scapulae are fragmentary. The glenoid cavity and neck occur repeatedly, and breakage at the neck, by separating

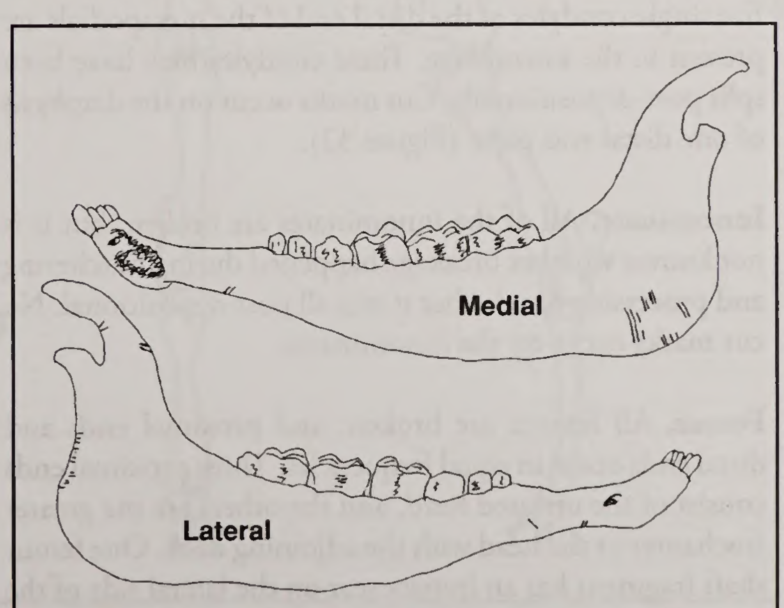



**Figure 31.** Location of cut marks (/) on a bison dentary from Area B.

the blade of the scapula from the glenoid, had probably occurred during carcass-butchering and processing.

Cut marks near the margins of the glenoid cavity of a left and a right scapula (Figure 32) probably had been imparted when the humerus was severed.

**Radius.** Two intact radii are present in the assemblage. The others are broken, separating the proximal end from the distal end. Four of the six proximal end pieces had been split longitudinally, but that breakage does not appear to have occurred when the bones were fresh. It is more likely that they had split after deposition as a result of drying and weathering. One of the four distal ends of radii had been split, but this also could be post-depositional damage.

One left proximal end piece has an impact scar on the anterior side of the diaphysis (Figure 32). The radii lack cut marks.

**Ulna.** All ulnae are broken. They occur as proximal end pieces and shaft pieces. Five of 10 proximal ends are intact, that is, they consist of the area of articulation with the proximal end of the radius, the semi-lunar notch, and the olecranon process. The five broken proximal ends lack part or all of the olecranon process. One shows carnivore chewing damage, and the remaining four may have been broken post-depositionally. The ulnae lack cut marks.

**Carpal.** All carpals are intact and lack cut marks.

**Metacarpal.** Eight metacarpals are whole, but the remainder are broken into proximal ends and distal ends. Three of the seven proximal end pieces are intact and the remaining four had been split lengthwise. At least one of the latter had split recently. Three distal ends are intact; however, five single condyles of the distal end of the metapodials are present in the assemblage. These condyles may have been split post-depositionally. Cut marks occur on the diaphysis of one distal end piece (Figure 32).

**Innominate.** All of the innominates are broken, but it is not known whether breakage happened during butchering and processing or whether it was all post-depositional. No cut marks occur on the innominates.

**Femur.** All femora are broken, and proximal ends and distal ends occur in equal frequencies. Three proximal ends consist of the unfused head, and the others are the greater trochanter or the head with the adjoining neck. One femur shaft fragment has an impact scar on the lateral side of the bone (Figure 32).

**Tibia.** No intact tibiae were recovered from Area B. Two left and one right unfused proximal epiphyses are present, as are two proximal diaphyses that lack the unfused epiphysis.

Nine of the 12 distal ends of tibiae are intact, and at least two of the other three distal ends probably had split recently. One left tibia shaft fragment has an impact scar on the lateral side of the shaft (Figure 32). None of the tibiae show cut marks.

**Tarsals.** All astragali are intact. Cut marks occur on the medial side of one left and one right astragalus (Figure 32). Three calcanei are fragmentary. One calcaneus displays cut marks on the lateral side (Figure 32). Four naviculocuboids had been broken, but the breakage on three of these may have been post-depositional. The remainder of the tarsals are intact and none has cut marks.

**Metatarsal.** Five left and four right metatarsals are whole. Four of the proximal end pieces are intact; the remainder had been split, some probably post-depositionally. The distal ends are all intact. One left proximal end has an impact scar on the medial side (Figure 32).

**Phalanx.** The phalanges were sided in the same manner as in the Area A analysis. All phalanges are intact except for seven 3rd phalanges. However, the breaks on these could have been caused post-depositionally. The phalanges lack cut marks.

**Bone Fragments.** Nine hundred and twenty-four long bone shaft fragments and 562 fragments were not identified as to skeletal part. Post-depositional breakage had greatly increased the number of bone fragments in the assemblage over the number originally deposited.

**Carnivore-Gnawed Bones.** Nine bones of bison show scoring, furrowing, or punctures probably imparted by carnivores gnawing on the bones (Table 22).

## Discussion

The Area B assemblage displays considerable variability in the relative frequency of skeletal parts (Figure 33). Hindlimb elements are most numerous, especially tarsal bones. Metatarsals also are abundant, especially when the number of intact ones is combined with the proximal end pieces. Phalanges are abundant. These skeletal parts are all of low economic utility.

Maxillae and dentaries are present in slightly less than 50 percent of MNI, based on tooth counts. Other moderately abundant parts are the scapula, radius, innominate,

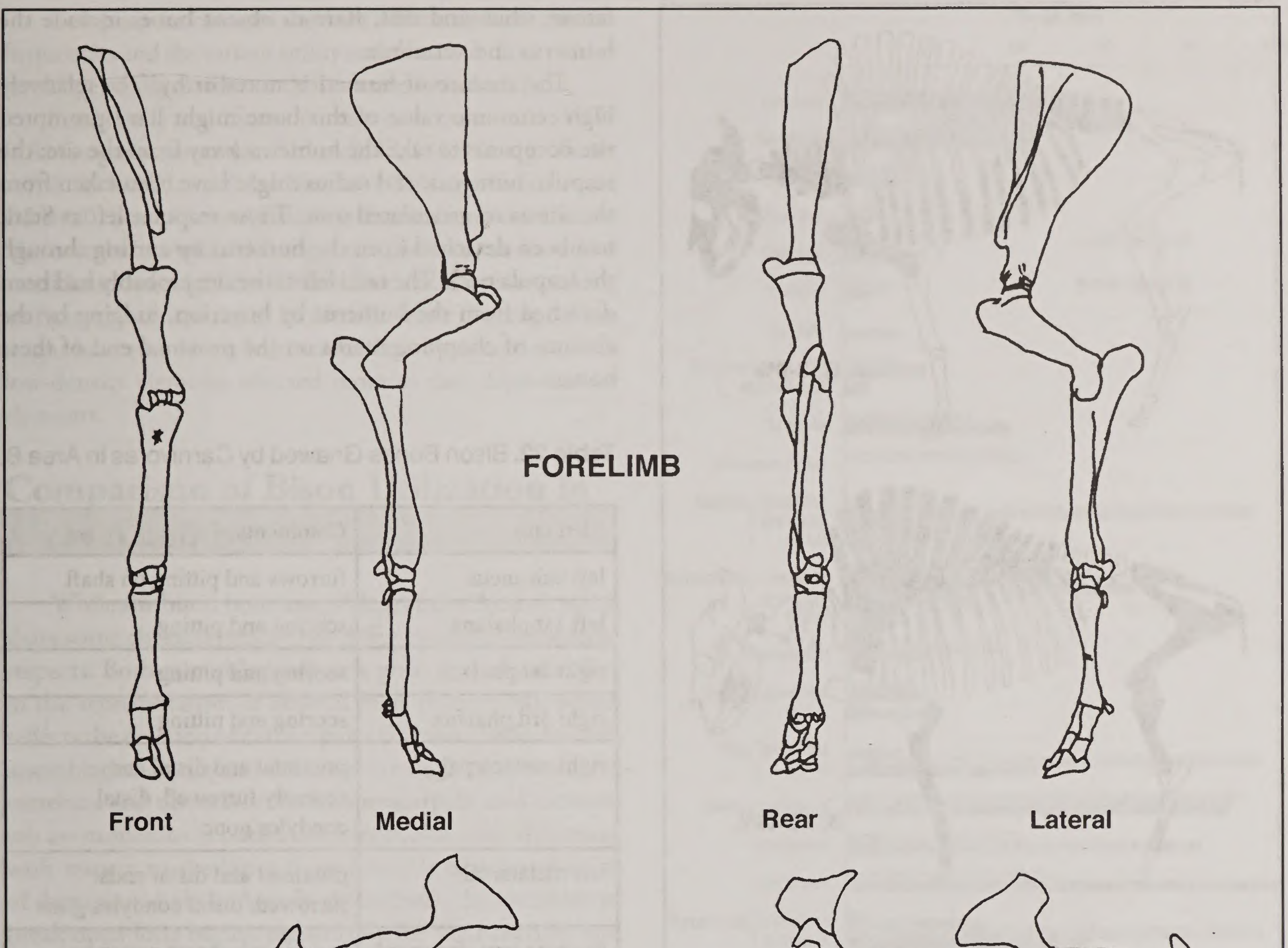



**Figure 32.** Location of cut marks (/) and impact scars (*) on bison forelimb and hindlimb bones from Area B.

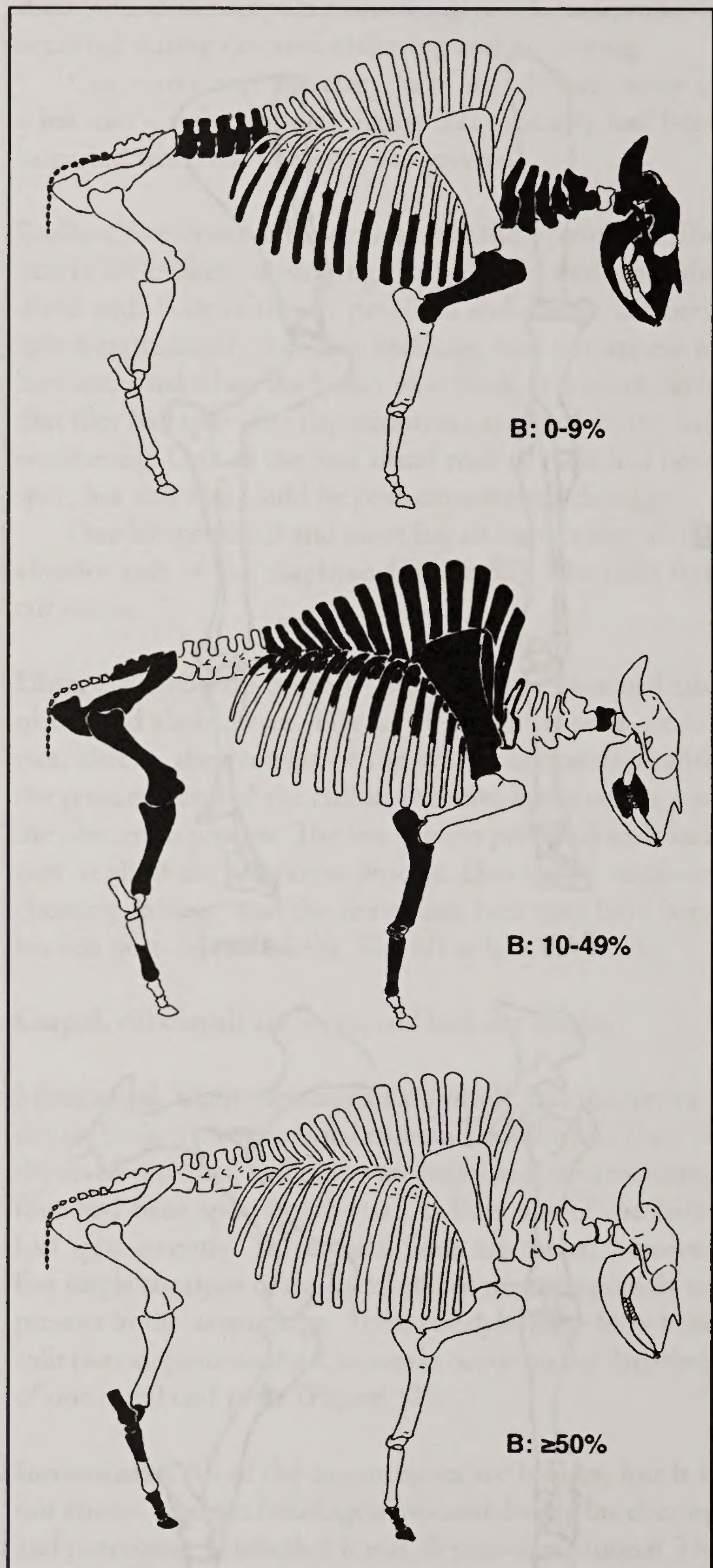



**Figure 33.** Diagram of bison skeleton showing the relative frequency of skeletal parts (Table 21, column 3) from Area B (Top: bones shaded black have a frequency of 0-9%; middle: bones shaded black have a frequency of 10 to 49%; bottom: bones shaded black have a frequency equal to or greater than 50%).

femur, tibia, and ribs. Rare or absent bones include the humerus and vertebrae.

The absence of humeri is noteworthy. The relatively high economic value of this bone might have prompted site occupants to take the humerus away from the site; the scapula, humerus, and radius might have been taken from the site as an articulated unit. Those scapulae left at Stark had been detached from the humerus by cutting through the scapula neck. The radii left at the site probably had been detached from the humerus by bisection, judging by the absence of chopping marks on the proximal end of these bones.

**Table 22.** Bison Bones Gnawed by Carnivores in Area B.

| Elements | Comments |
|---|---|
| left calcaneus | furrows and pitting on shaft |
| left 1st phalanx | scoring and pitting |
| right 1st phalanx | scoring and pitting |
| right 3rd phalanx | scoring and pitting |
| right metacarpal | proximal and distal ends severely furrowed, distal condyles gone |
| left metatarsal | proximal and distal ends furrowed, distal condyles gone |
| thoracic vert. fragment | neural arch shows punctures |
| right 2nd phalanx | scored and pitted |
| rib midshaft fragment | scored near vertebral end |

Most of the ribs and vertebrae apparently had been taken from the site, as had many innominates, femora, and proximal ends of tibiae. Some intact tibiae had probably removed from the site, and, in those cases, it seems likely that the femur and tibia would have remained articulated.

Nineteen long bones in Area B are whole (2 radii, 8 metacarpals, and 9 metatarsals). The other long bones had been broken, probably to extract their marrow and perhaps to detach unwanted bone ends from desirable portions, e.g., removal of the distal end of the tibia.

Widespread exfoliation of the outer bone surface in the Area B assemblage probably eliminated a substantial portion of cut marks that might once have been present on bones.

As was the case in Area A, the bone fragments do not seem to reflect breakage and reduction for bone grease production at this location.

Comparisons between the Area B bison skeletal element frequencies and the various utility and density indices yielded results generally similar to those derived for Area A.

Statistically significant correlations exist with BGW (-.814; significant at the .01 level), FUI (-.398; significant at the .05 level), and Bone Density (.346; significant at the .05 level). Bone Grease Utility has the strongest correlation. The correlation with FUI suggests that meat and marrow considerations might have influenced the decision-making and carcass-use strategies in Area B. Bone decomposition might have played a role in assemblage composition, with low-density elements affected more so than high-density elements.

## Comparison of Bison Utilization in Areas A and B

While the bison bone assemblages from Areas A and B share some characteristics, they differ in several interesting respects. Both assemblages show a great deal of variability in the representation of skeletal parts (Figure 34), which reflects the deletion of certain parts (Lyman 1985). In both assemblages, crania and dentaries are fairly abundant and vertebrae and ribs scarce. Radii, metacarpals, and metatarsals are numerous in both assemblages. A notable difference with respect to the latter three bones is that many more of them are whole in Area B. Apparently, the incentive to break open long bones, presumably for their marrow and perhaps also to detach unwanted ends, had been weaker in Area B. Astragali, calcanei, and phalanges are less numerous in Area A, which is not expected given the large numbers of metatarsals. The absence of humeri in Area B contrasts with relatively abundant distal ends in Area A. That reflects different treatment of the forelimb across the two areas; in Area B, upper forelimbs had probably been removed from the site as unprocessed units, whereas in Area A the bones had been broken. Since distal ends of tibiae are less common in Area B, it is possible that femora with articulated whole tibiae had been more often transported away from Area B more often than from Area A.

Bone parts with the highest value for bone grease production, the proximal ends of the humerus and tibia and the distal end of the femur, are scarce or absent from both areas. These parts seem to have been deleted systematically from the site, probably for bone grease-processing elsewhere. It should be borne in mind, however, that these bone parts have a relatively low resistance to destruction by natural forces; it is thus possible that natural attrition caused some of the observed bone element under-representation (see Lyman 1985).

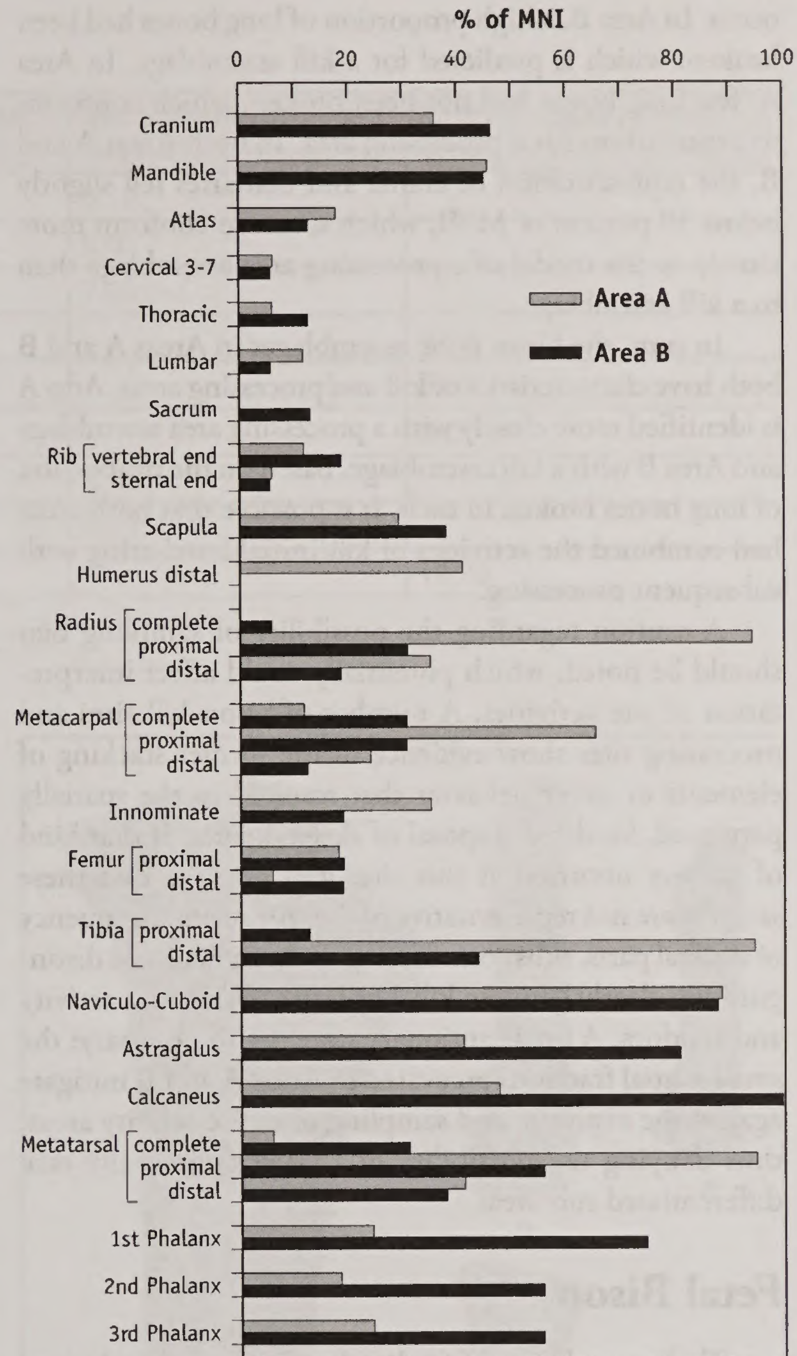



**Figure 34.** Histogram comparing the relative frequency of bison skeletal parts from Areas A and B.

The bison bone assemblage compositions in Areas A and B do not meet the predictions for a campsite. The Stark site bone assemblages are indicative of either kill areas, processing areas, or a combination of both activities. In neither area can any one of these three possibilities be clearly singled out as the most likely answer on the basis of the faunal assemblage alone. The very high relative frequency of metapodials in both areas and phalanges in Area B argues for a kill type of assemblage. However, a relatively high frequency of those bones in a processing area is conceivable (see Wheat 1978:88; Roll and Deaver 1980:44,56). A scarcity of vertebrae probably is more likely in a processing area than in a kill area, but the opposite situation may also

occur. In Area B, a high proportion of long bones had been broken, which is predicted for a kill assemblage. In Area A, few long bones had not been broken, which conforms to expectations for a processing area. In both Areas A and B, the representation of crania and dentaries fell slightly below 50 percent of MNI, which seems to conform more closely to the model of a processing area assemblage than to a kill assemblage.

In sum, the bison bone assemblages in Areas A and B both have characteristics of kill *and* processing areas. Area A is identified more closely with a processing area assemblage and Area B with a kill assemblage, based on the proportion of long bones broken in each. It is possible that both areas had combined the activities of kill/initial butchering with subsequent processing.

A caution regarding the possibility of sampling bias should be noted, which potentially could affect interpretation of site activities. A number of bison kill sites and processing sites show evidence of the former stacking of elements or other behavior that resulted in the spatially patterned, localized disposal of skeletal parts. If that kind of activity occurred at this site, it is possible that these samples are not representative of the true relative frequency of skeletal parts, thus contributing to the difficulty in distinguishing clearly between kill versus processing area activity and residues. A final cautionary note is also necessary: the small spatial fractions excavated in Areas A and B mitigate against the exposure and sampling of entire activity areas, thus denying the possibility of studying internally task differentiated sub-areas.

## Fetal Bison

Thirty-two bones of fetal and possibly neonatal bison were recovered from Area A (Table 23) (Figures 35-38). These elements encompass a wide size range that reflects the deaths of individuals at various stages of fetal development (Table 24). Five size or growth and development categories are tentatively recognized. Category 1 includes the largest bones and Category 5 the smallest. The number of categories is tentative because the largest number of size categories represented by any single element is three and because the lack of available comparative specimens hampered the fine determination of the relative size proportions of different skeletal elements during stages of fetal development. Although all bones in Category 1 are fragmentary, it was evident from their large proportions that they represent nearly full-term fetal development or perhaps even newborn bison. Bones in Category 5 are very small; the humerus is comparable in size to the small fetal humeri from the Big Goose Creek site in Wyoming, for which death during winter was suggested (Frison et al. 1978:43).

Bison have a seasonally restricted birthing season, with the peak of birthing in April and May (Meagher 1973:75;

**Table 23.** Area A Fetal Bison Bones.

| Catalog # | Element | Size Category |
|---|---|---|
| A-1 | fetal right humerus diaphysis | 5 |
| A-2 | fetal left radius diaphysis | 5 |
| A-3 | fetal right radius diaphysis | 4 |
| A-4 | fetal right femur diaphysis | 4 |
| A-5 | fetal right scapula | 4 |
| A-6 | fetal right scapula | 4 |
| A-7 | fetal left scapula | 4 |
| A-8 | fetal left tibia diaphysis | 4 |
| A-9 | fetal metapodial diaphysis half | 4 |
| A-10 | fetal metapodial diaphysis half | 5 |
| A-11 | fetal metapodial diaphysis half | 4 |
| A-12 | fetal metapodial diaphysis half | 4 |
| A-13 | fetal left ulna diaphysis | 4 |
| A-14 | fetal right radius diaphysis | 3 |
| A-15 | fetal left femur diaphysis | 3 |
| A-16 | fetal left tibia diaphysis | 4 |
| A-17 | fetal left tibia diaphysis | 2 |
| A-18 | fetal right ulna diaphysis | 2 |
| A-19 | fetal right humerus diaphysis | 2 |
| A-20 | fetal right ischium | 4 or 5 |
| A-21 | fetal right ilium | 2 |
| A-22 | fetal left ischium | 2 |
| A-23 | fetal or neonatal right femur diaphysis | 1 |
| A-24 | fetal or neonatal right femur distal diaphysis | 1 |
| A-25 | fetal or neonatal right humerus diaphysis | 1 |
| A-26 | fetal or neonatal right ulna diaphysis | 1 |
| A-27 | fetal or neonatal first phalanx proximal epiphysis | 1 |
| A-28 | thoracic vertebra dorsal spine | 4 or 5 |
| A-29 | long bone diaphysis fragment | 3 or 2 |
| A-30 | fetal or neonatal long bone diaphysis fragment | 1 |
| A-89 | fetal or neonatal right mandible | 1 |
| A-90 | right scapula | 3 |

**Table 24.** Area A Fetal Bison Bone Measurements (mm).

| Catalog # | Element | Diaphysis Length | Min. anterio-posterior dm. at midshaft | Min. transverse dm. at midshaft | Smallest length of neck* |
|---|---|---|---|---|---|
| A-1 | humerus | | 6.55 | 6.10 | |
| A-2 | radius | 32.85 | 3.95 | 6.05 | |
| A-3 | radius | 38.35 | 5.00 | 7.85 | |
| A-5 | scapula | | | | 9.00 |
| A-6 | scapula | | | | 9.20 |
| A-7 | scapula | | | | 9.05 |
| A-14 | radius | 43.65 | 4.85 | 8.15 | |
| A-15 | femur | 48.70 | 7.70 | 7.70 | |
| A-90 | scapula | | | | 12.70 |

*This measurement was taken following von den Driesch (1976: Fig. 31a,75).

Frison and Reher 1970:46). The largest bones represent death in the spring, unless those animals are out-of-season fetuses. Out-of-season fetuses have been recognized at bison kill sites (see Wilson 1974:151-152), but it is possible that bison-killing at the Stark site was carried out both in winter and spring.

Although five size categories of fetal bones are tentatively represented at Stark, it does not necessarily follow that five separate kill events occurred in Area A. Although bison birthing is seasonally restricted, it is possible or even probable that, within a single population, the temporal spacing of conception within the breeding period will yield fetuses that show slightly different stages of development at any one time (see Pac and Frey 1991).

It seems safe to conclude, based on the fetal remains, that these bison in Stark site Area A were killed in winter and early spring, and perhaps into mid- or late spring.

One fetal bone diaphysis has incisions that partially encircle the shaft. These are either cut marks or tooth marks imposed by a scavenger; the former seems the more likely.

The skeletal representation of fetal bones is interesting. Limb bones dominate the assemblage. Skulls are absent, and only one vertebra is present. These selective occurrences may be a result of cultural activities, but the evidence is insufficient to allow firm conclusions. Differential preservation could also account for the low frequency of axial parts. The fetal bone assemblage from Big Goose Creek also had axial elements under-represented in the small size category. However, scapulae and ulnae were also under-represented there (Frison et al. 1978:45), which does not appear to be the case at Stark.

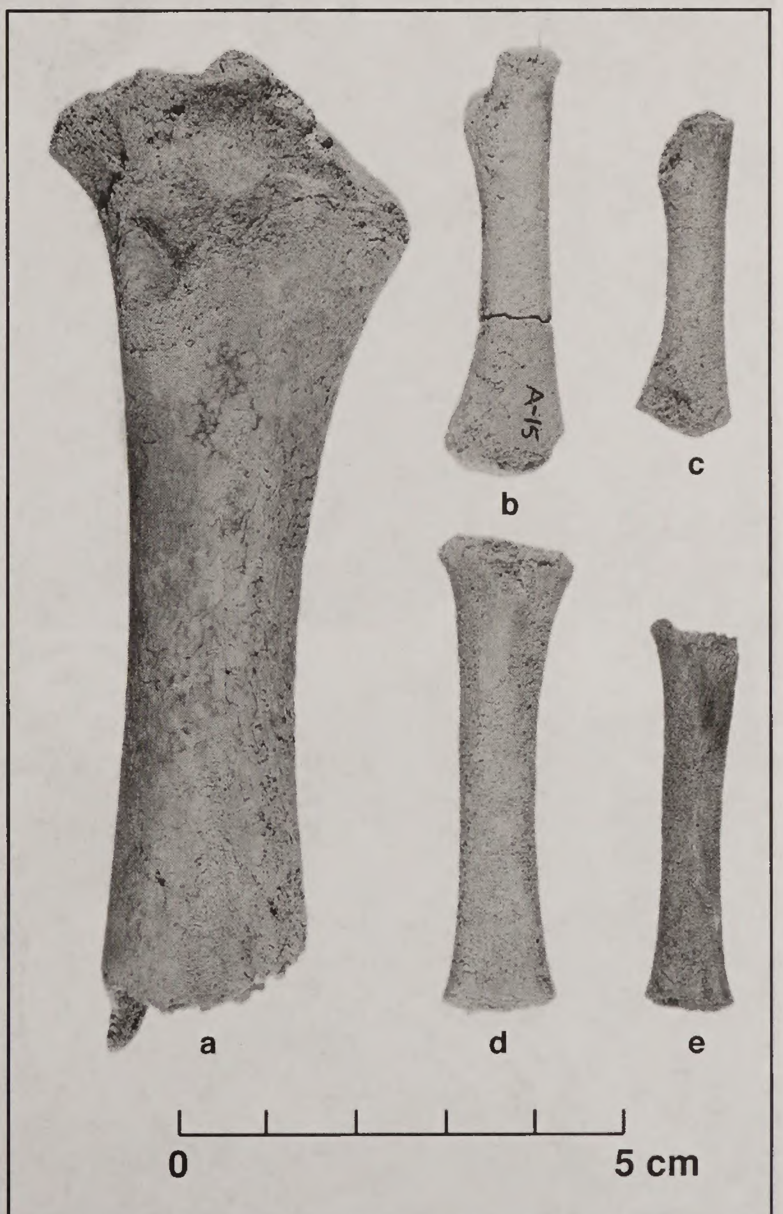



**Figure 35.** Fetal and possibly neonatal bison bones from Area A.


**Figure 36.** Fetal and possibly neonatal bison bones from Area A.

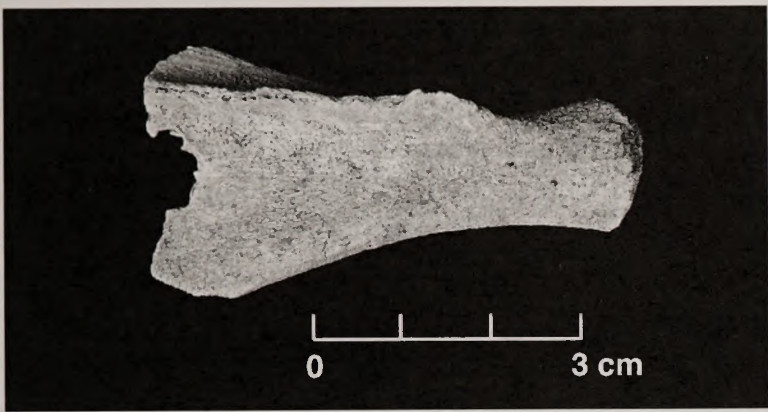



**Figure 37.** Fetal bison scapula from Area A.

## Seasonality As Indicated by Bison Dentition

Most of the bison teeth in Areas A and B are isolated and fragmentary. Four partial dentaries and four partial maxillae, each containing two or more cheek teeth, occur in Area A. Area B contained one left dentary with all cheek teeth, two partial dentaries, and a partial maxilla.

Bison dentaries from Areas A and B were examined to estimate the season of death for represented animals. The teeth were aged using criteria published by Frison and Reher (1970), Frison et al. (1976), Reher and Frison (1980), and Clark and Wilson (1981).

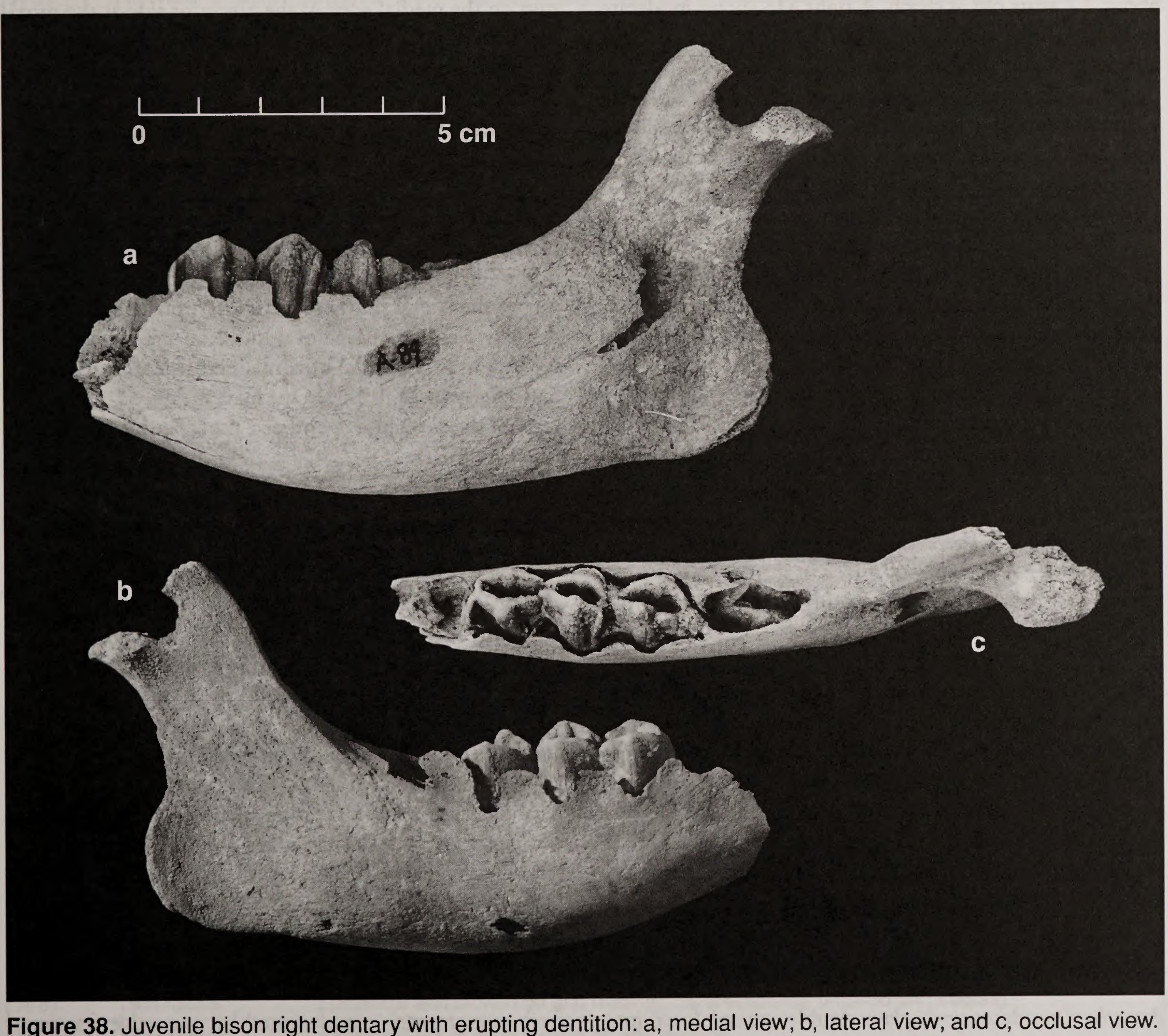



**Figure 38.** Juvenile bison right dentary with erupting dentition: a, medial view; b, lateral view; and c, occlusal view.

**Area A.** Three isolated molars and one molar within a broken dentary allow estimation of the season of death. One specimen consists of a partially erupted right M2 within a fragmentary dentary (Figure 38). The posterior cusp is partly enclosed within the alveolus. The occlusal surface of facets I and III and part of II had been broken off. The tooth shows very slight wear on facet II and no wear on the other facets (see Frison et al. 1976:38-39 for wear facet nomenclature). This animal probably died at about 1.6 years of age.

A second specimen, an isolated left M2, shows wear on facets I-IV. This animal probably died at about 1.7 years of age.

A left M3 has wear facets I and II, and was probably about 2.7 years old at death. A right M3 shows moderate wear on facets I and II and slight wear on facet III. This animal probably died at about 2.8 years of age.

Assuming bison birthing in April or May, the 1.6-year-old animal probably died in the October-December period, and the 2.8 year old probably died in the December-February period. The 1.7 year old and 2.7 year old probably died during the November-January period.

The bison dentitions from Area A thus indicate that the bison had been killed in the fall and/or early winter of the year. Because of the small sample size, the noted dispersion of age at death likely does not indicate multiple, temporally spaced kill events. A larger sample would be necessary to ascertain with confidence whether age dispersion of that magnitude represents temporally spaced kills or natural variation in age attributable to spacing in the time of birth of the animals, differential tooth wear, and so on.

In sum, given the small sample size, it is prudent to conclude that, on the basis of available dentition, bison killing in Area A probably occurred in the fall and/or winter and that perhaps more than a single kill had transpired within that time span.

**Area B.** One dentary molar, a left M3, provides an indication of seasonality for Area B. That tooth shows wear on facets I and II. Facets III, IV, and IX show no wear; facets V-VIII, which had been broken away, presumably lack wear. That animal was probably about 2.6 years of age at death somewhere in the October-December period. That seasonality determination must be considered tentative, based as it is on an inadequate dental sample.

## Bison Pathologies and Anomalies

**Area A.** One dentary displays double mental foramina, rather than the normal single foramen. A right dentary has a slight swelling on the lateral side adjacent to P4. A fragment of a dentary molar has a pair of conical enamel projections on the medial side of the tooth near the occlusal surface. The projections are rooted together on the anterior or posterior side of the tooth; one projects medially 2.5 mm and the other projects at a right angle to the first one for a distance of 2.9 mm. A right P4 lacks the posterior loop on the medial side of the tooth. An oval ring of enamel, which occurs on the occlusal surface in place of the loop, encloses an "island" of dentine. A small fossa is present in the center of this dentine "island." The absence of the enamel loop does not seem to be the result of heavy attrition of the tooth because the crown was fairly deep, even though its base had broken off.

A left metatarsal displays a fossa that measured 11 x 9 mm on the medial edge of the posterior side at the proximal extremity of the bone. This fossa is about 3 mm deep and the interior surface is coarse. The proximal articular surface at the same corner of the bone projects upward to an abnormal height, and the medial articular facet of the proximal surface of the bone displays four tiny wrinkles.

**Area B.** Two dentaries have double mental foramina. One or two additional unrecorded specimens may be present in the site assemblage. A left dentary shows a slight swelling on the lateral side below P4. A 1st phalanx from Area B has two closely spaced oval fossae on the medial side of the diaphysis, near the proximal end (the unfused proximal epiphysis is missing). One fossa measured 9 mm in its greatest diameter and the other 7 mm. The insides of these fossae are coarse.

## Discussion

The anomalous shape of the P4 from Area A may be genetic in origin (Clark and Wilson 1981:60), but the cause of double mental foramina is uncertain at this time.

The two cases of swelling of the dentary may be the result of a low-grade infection at the tooth root, perhaps initiated by the penetration of food along the tooth (Baker and Brothwell 1980:158; Wilson 1974:170).

The fossae on the metatarsal and the 1st phalanx might be an effect of a local infection, although other causes are possible. The causes of the other abnormalities noted for the metatarsal are also unclear.

## Non-Bison Species

**Area A.** Six non-bison taxa occur in Area A (Table 16). A freshwater mussel is represented by one valve fragment. A partial cranium and left dentary of a pocket gopher (*Thomomys* sp.) probably are recent intrusions, judging by

**Table 25.** Canid Bones from Area A.

| Catalog # | Element | Comments |
|---|---|---|
| A-31 | right dentary | intact; m1 and m2 present |
| A-32 | left dentary | intact; weathered on medial side; teeth present are i2-3, c1, p1-m2; all teeth heavily worn; possible periodontal deterioration of alveolus at m1 |
| A-33 | right dentary | intact expect for top of coronoid process; weathered on lateral side; teeth present i2, c1, p1-m2; all teeth were heavily worn; A-33 and A-32 were partners from the same individual; swelling present on medial side of dentary adjacent to p4-m1 |
| A-34 | right dentary | anterior end broken off at p2 and missing; top of coronoid process missing; teeth present are m1 (broken) and m2 |
| A-35 | atlas vertebra | nearly intact, part of left wing weathered away |
| A-36 | axis vertebra | nearly intact, part of right transverse process missing |
| A-37 | cervical vertebra | (one of the 3-7 series) nearly intact, tips of transverse processes missing |
| A-38 | cervical vertebra | (one of the 3-7 series) part of neural arch recently broken off; transverse process missing; moderate osteophytic lipping on margins of the anterior surface of the vertebra body |
| A-39 | right ulna | distal half of shaft recently broken off and missing |
| A-40 | left tibia | proximal end broken off and missing; diaphysis showed several slight indentations, possibly carnivore tooth marks |
| A-41 | left astragalus | intact |
| A-42 | right metatarsal IV | distal end broken off and missing |
| A-43 | right metatarsal V | intact |
| A-44 | right metatarsal III | proximal end recently broken off and missing |
| A-45 | left metatarsal V | distal half broken off and missing |
| A-46 | right metatarsal III | intact |
| A-47 | metacarpal I | incisions present on diaphysis; possibly cut marks |
| A-48 | 1st phalanx | arthritic bone growth on diaphysis |
| A-49 | 1st phalanx | intact |
| A-50 | 2nd phalanx | arthritic bone growth on diaphysis |
| A-51 | 2nd phalanx | intact |
| A-52 | 2nd phalanx | the surface of the bone was eroded and thinned; probably this bone had passed through an animal's digestive system |
| A-53 | 3rd phalanx | intact |
| A-82 | 3rd phalanx | intact |
| A-54 | rib | midshaft fragment, possibly canid |
| A-55 | rib | midshaft fragment, possibly canid |
| A-56 | rib | midshaft fragment, possibly canid |
| A-57 | rib | fragmentary, vertebral end, possibly canid |
| A-58 | rib | fragmentary, vertebral end, possibly canid |
| A-59 | 2 nasal bones? | paired, possibly canid |
| A-84 | axis vertebra | intact |
| A-85 | cervical 7 vertebra | intact |
| A-86 | right radius | intact diaphysis, proximal and distal epiphyses unfused and missing |
| A-87 | left radius | proximal end broken off and missing; distal epiphysis unfused and missing |
| A-88 | right ulna | proximal 3/4 of shaft broken off and misisng |

**Table 26.** Area A Canid Dentary Measurements (mm).

| Catalog # | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| A-31 | - | - | 90.3 | 43.9 | 48.5 | 26.7 |
| A-32 | 170.0 | - | 89.4 | 43.4 | 47.5 | - |
| A-33 | 170.0 | 170.0 | 87.9 | 43.0 | 46.1 | - |
| A-34 | - | - | - | 19.8 | - | - |

1 = total length: from condyle process to infradentale.
2 = length: from angular process to infradentale.
3 = length of cheek tooth row, from m3-;1, measured along the alveoli.
4 = length of molar row, measured along the alveoli.
5 = length of premolar row, p1-p4, measured along the alveoli.
6 = length of carnassial.

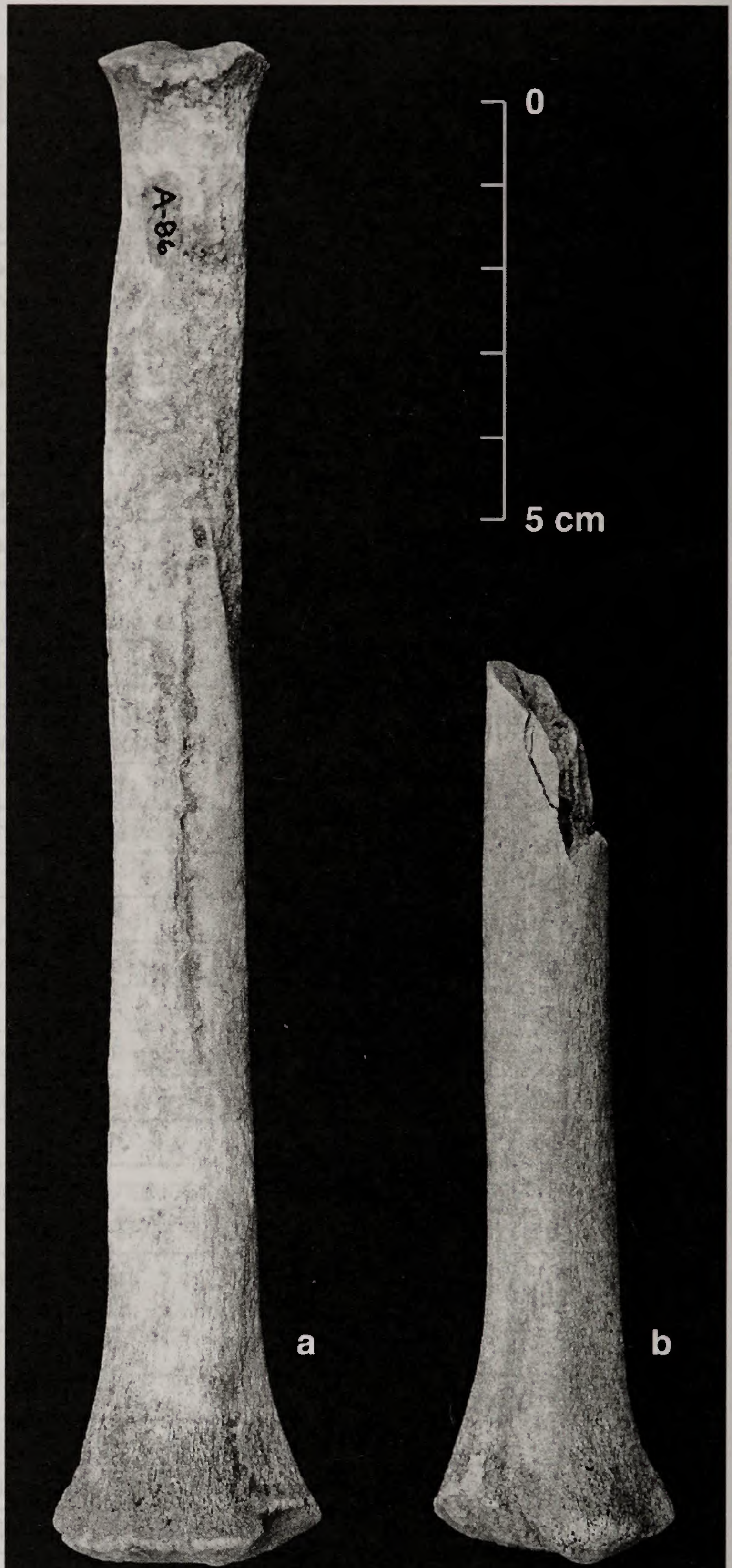



**Figure 39.** Area A: (a) canid right radius (A-86), proximal and distal epiphysis unfused and missing; (b) canid left radius, distal epiphysis unfused and missing.

the preservation and color of the bones. A right femur of an unidentified rodent also appears to be recent. A perforated elk (*Cervus elaphus*) tush ornament was recovered. Canids of two sizes occur in Area A. Swift fox *(Vulpes velox)* is represented by a fragmentary dentary (Table 26), and two large canids are represented by various skeletal elements (see Tables 25 and 26). These canids are discussed in more detail below. A medium-sized artiodactyl (cf. *Antilocapra americana*) is represented by the distal end of a 2nd phalanx, a fragment of the proximal end of a metatarsal, and a fragment of the blade and spine of a left scapula.

**Area B.** A medium-sized artiodactyl is represented by a partial right scapula.

## Canid Remains

Twenty-three bones of canids were recovered from Area A, along with seven other bones that are probably from canids (Table 25). The recovered canid elements include dentaries, cervical vertebrae, ulnae, radii, a tibia, several metapodials, and several phalanges (Figures 35-42). The probable canid bones include several rib fragments. Two articulated bones that appear to be nasal bones also could be from a canid.

Two sizes of canid are represented in the assemblage. One fragmentary dentary was derived from a swift fox (*Vulpes velox*) (Catalog #A-34) (Figure 42a). The rest of the bones are substantially larger than coyote (*Canis latrans*). At least two large individuals are represented by three dentaries and by two right 3rd metatarsals. Two dentary halves are derived from a single canid (A-32 and A-33).

The large canids are interesting with regard to the question of whether they are dogs, wolves, or hybrids of these species. Several features of these dentaries suggest that these canids were not wild. The two dentaries attributed to one individual have heavily worn teeth (Figure 42 b-c). The incisors are peg-like, the canine tips are blunted and smooth, and the crowns of the premolars and molars are flat. Although the M1 is badly broken in both dentaries,


**Figure 40.** Area A; canid right ulna, distal end.

enough of these teeth remain to indicate that they had been worn down especially heavily. It is possible that the canines and carnassials had been deliberately broken off by humans during the animal's lifetime and had become smooth (see Walker 1975:221; Walker and Frison 1982:131). The combination of severe tooth wear (indicating old age) and possible cultural modification of teeth indicate that a close relationship existed between these canids and humans. The right dentary shows swelling, and a fossa under the carnassial may have been caused by infection, which in turn could have resulted from the intentional breaking off of that tooth. Several canid skulls from prehistoric sites in Wyoming display canine teeth and carnassials that had been deliberately broken during the animals' lives (Walker 1975; Walker and Frison 1982).

The third large dentary from Stark (A-31) (Figure 42 d) contains the M1 and M2, the other teeth having been lost postmortem. The M1 and M2 of this animal are lightly worn, the cusps are still prominent, and the teeth had not been broken.

Large canid skulls from several prehistoric archaeological sites in Wyoming have been compared to wolf and dog samples, and it appears that the Wyoming specimens are hybrids of wolf and dog (Walker and Frison 1982). Unfortunately, the Stark canid bones do not include crania, the most useful element in such studies. Walker and Frison (1982: Fig. 11, a-b) compared dentaries in two separate bivariate plots. The first showed the relationship between the length of the carnassial and the alveolar length of the molar tooth row and the second showed the relationship between the length of the carnassial and the alveolar length of the premolar row. The first of these comparisons separated dogs, wolves, and hybrids into fairly discrete clusters. The one Stark dentary that could be measured (A-31) falls within the cluster of Wyoming hybrids. The second plot shows slightly more overlap between wolves and the Wyoming hybrid canids, but the Stark specimen again falls within the cluster of Wyoming canids (see Table 26 for measurements of the Stark canid dentaries).

Thus, it seems possible that specimen #A-31, which shows no cultural modification, is a wolf-dog hybrid. Unfortunately, the other two large canid dentaries could not be plotted because of breakage on the carnassial teeth. It is possible that the individual represented by these paired dentaries also is a hybrid because of the similar size to specimen #A-31 and because the probable cultural modification of the teeth and heavy wear indicate that the animal was not wild.

Arthritic lipping is present on three canid bones: a cervical vertebra, a 1st phalanx, and a 2nd phalanx. Lipping may be a function of advanced age, trauma, or culturally induced damage associated with pulling travois and so forth.

Incisions on the diaphysis of a canid metacarpal might be cut marks.

## Summary and Conclusions

Analyses of faunal remains recovered from two of the partially extant, spatially and culturally discrete activity areas at the Stark site were presented above. In both Areas A and B, bison is the most numerous single species utilized. An MNI of 17 bison is represented in Area A, with 16 in Area B.

Non-bison fauna at Stark consist of a medium-sized artiodactyl in Area B and a mussel, a wapiti tooth, a medium-sized artiodactyl, and a small canid and two large canids in Area A. The large canids may be wolf-dog hybrids. The teeth of one may have been culturally modified during the animal's lifetime, and measurements of the dentary of the other large canid fall within the range of wolf/dog hybrids from prehistoric sites in Wyoming.

In both areas at Stark, bison were butchered and those parts rich in meat and/or bone grease removed, presumably for processing elsewhere. The two assemblages differ somewhat in several details of butchering, such as where on the limbs the separation had been made so that unde-

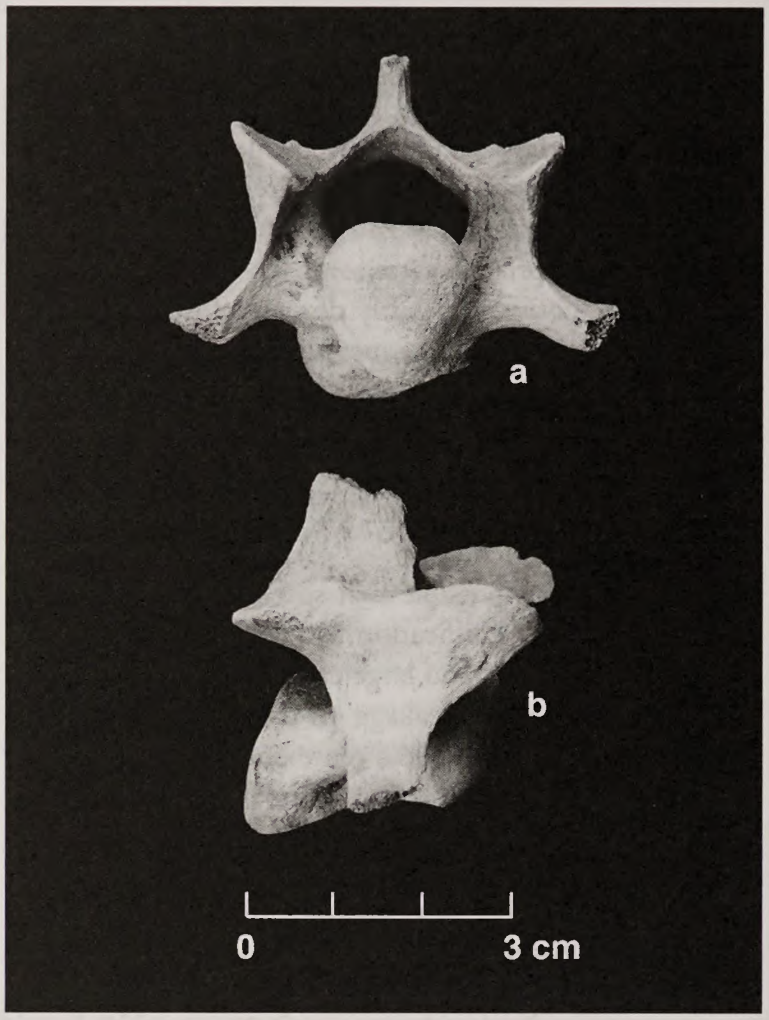



**Figure 41.** Area A: (a) canid cervical vertebra, lateral and anterior views; (b) Area A: canid cervical vertebra, lateral view.

sirable parts could be left behind. For example, in Area B, forelimb units consisting of scapula, humerus, and radius seem to have been removed from the site, and hindlimb units consisting of the femur and intact tibia had frequently been taken away. In Area A, the transported forelimb unit often consisted of the scapula and proximal end of the humerus and, alternatively, the scapula and entire humerus, whereas radii seem not to have been taken away from the site. Hindlimb units lack the distal end of the tibia.

The Area A assemblage reflects more thorough use of carcasses for food. Almost all long bones had been broken open, probably for marrow extraction. In the Area B assemblage, unbroken long bones are relatively common.

Several explanations can be advanced to account for apparent differences in butchering and utilization of carcasses between the two Stark site areas faunal assemblages. Some of the different patterns of carcass use may be a function of the logistics of transporting bison carcass parts from the Stark bison kill areas to the processing and consumption location. If the distance had been short, large units could have been carried off, as was suggested for Area B. Area A occupants might have been concerned about weight and thus they chopped distal ends off of humeri, tibiae, and other low-quality parts. However, the low frequency of phalanges in Area A does not seem to fit that interpretation. Alternatively, the two areas may have differed functionally; for example, Area A might have combined initial butchering with processing, while, in Area B, only initial butchering occurred and further processing was deferred and accomplished elsewhere.

The intensity of long bone breakage for marrow at Stark could be a function of the ratio of people to number of carcasses; a small group might have had its fill of marrow before all marrow bones were cracked, for instance. The duration of site occupation could also have affected the number of bones broken open for marrow.

The Area A kill event or events probably took place in the winter, with a possible spring bison kill indicated by fetal bones. Death in the fall of the year is suggested by certain teeth. While cold Plains winters undoubtedly stressed resident human and bison populations in that area, cold temperatures would have prolonged the edibility of perishable meat.

The speculative tone of this discussion derives from, and highlights, the fact that much remains to be learned about relationships between archaeological faunal assemblages and dynamics of prehistoric human adaptations in the Northwestern Plains.

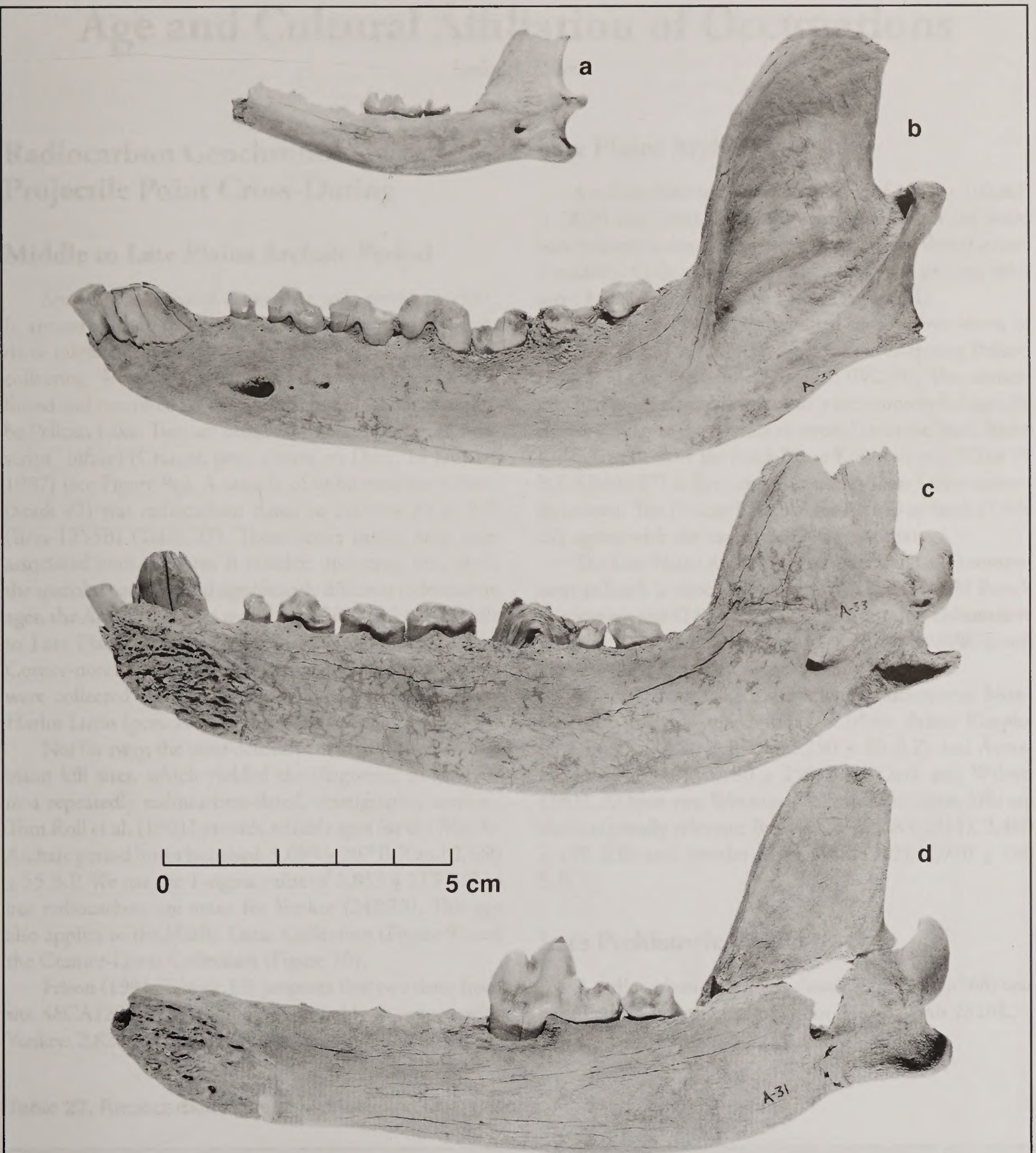



**Figure 42.** Area A: canid dentaries (a-d).

# Age and Cultural Affiliation of Occupations

*Leslie B. Davis*

## Radiocarbon Geochronology and Projectile Point Cross-Dating

### Middle to Late Plains Archaic Period

Area D was revisited during the soils survey in 1985. It appeared that the primary artifact-bearing deposits there might not have been eliminated entirely by artifact-collecting. When Cramer and Lewis sampled Area D, they found and recovered six dart points, five of which appear to be Pelican Lake. Two are obsidian (including the "nondescript" biface) (Cramer, pers. comm. to Davis 14 January 1987) (see Figure 9g). A sample of unburned bison bone (Stark #7) was radiocarbon dated to 2,150 ± 80 yr B.P. (Beta-1255B) (Table 27). These bones might have been associated with the Area B midden upstream, but, given the spatial separation and significantly different radiocarbon ages, the Area D deposits may derive from a recent Middle to Late Plains Archaic Period bison procurement event. Corner-notched and side and basal-notched dart points were collected from Area D previously, as indicated by Harlin Lucas (pers. comm. to Davis, various).

Not far away, the most definitive of investigated Yonkee bison kill sites, which yielded the diagnostic point type in a repeatedly radiocarbon-dated, stratigraphic context, Tom Roll et al. (1991) provide reliable ages for the Middle Archaic period bison bonebed: 3,089 ± 207 B.P. and 2,680 ± 55 B.P. We use the 1-sigma value of 2,853 ± 115 B.P. as our radiocarbon age mean for Yonkee (24PR5). This age also applies to the Harlin Lucas Collection (Figure 9) and the Cramer-Lewis Collection (Figure 10).

Frison (1991: Table 2.13) proposes that two dates from site 48CA1291 in Wyoming are probably associated with Yonkee: 2,820 ± 50 and 2,760 ± 60. He is probably correct.

### Late Plains Archaic Period

A radiocarbon age on bone collagen of 2,720 ± 100 B.P. (I-7848) was obtained from a sample of unburned bison bone selected from the upper layer of bones within the Area B midden. Only a single deposit of bone was present, with some bones touching those below (Figure 14).

Roll et al. (1994:49) obtained radiocarbon dates of 2,160 ± 50 and 1,920 ± 50 from two overlapping Pelican Lake strata at the Seline Site (24DW250). The corner-notched point assemblage is clearly technomorphologically closely similar to dart points recovered from the Stark Bison Kills, Area B. Why the Stark Bison Kills date of 2,720 ± 90 B.P. (Table 27) is five centuries earlier than Seline cannot be known. The Pelican Lake age for Area D at Stark (Table 27) agrees with the earlier Seline age estimate.

The Late Plains Archaic period (=Pelican Lake) component at Stark is about the same age as the Garfield Ranch occupation site (24GV117) west of Roundup (Munson et al. 1990: Table 8-1): 2,640 ± 80 B.P. [Brumley 1987]; and 2,940 ± 90 B.P. and 2,060 ± 130 B.P.

Other Pelican Lake bison kills in southeastern Montana also provide relevant radiocarbon dates: Koepke (24GF660), 2,280 B.P. and 2,290 ± 80 B.P.; and Ayers-Frazier (24PE30), 2,180 ± 150 B.P. (Clark and Wilson 1981). At least two Wyoming Pelican Lake bison kills are also temporally relevant: Buffalo Creek (48SH311), 2,460 ± 140 B.P.; and Powder River (48SH312), 2,910 ± 140 B.P.

### Late Prehistoric Period

A radiocarbon age of less than 250 B.P. (RL-768) was obtained for hearth charcoal from Area A, Unit 2S10E.

**Table 27.** Radiocarbon Ages of Middens and Occupations.

| Provenience | Sample # | Organic Material | $^{14}$C Lab # | Uncorrected Age B.P. | Conventional Age B.P. | $^{C}13/^{C}12$ |
|---|---|---|---|---|---|---|
| Area A | SBK-97-1 | unburned canid bone (collagen) | Beta-105644 | 260 ± 50 | 340 ± 50 | -14.1 |
| Area A Unit 2S10E | | hearth charcoal | RL-768 | 250 ± 50 | | |
| Area B | | unburned bison bone (collagen) | I-7848 | 2,640 ± 90 | 2,720 ± 90 | |
| Area D | Stark #7 | unburned bison bone (collagen) | Beta-12558 | 2,080 ± 70 | 2,160 ± 70 | |

## Obsidian Source Determination

Three others originate from the Obsidian Cliff Plateau in northwestern Wyoming (see Davis et al. 1995:157). The Wyoming source might be applicable as a basis for sourcing all Stark obsidian artifacts. We elect to apply the non-source-derived rate of $3.83\mu^2/1,000$ years B.P. developed previously by (Davis 1972) for the Central-Southern Montana Plains hydration sub-region.

## Obsidian Hydration Age Estimation

Twenty-eight archaeological obsidian artifacts (see Figures 20 and 21 for obsidian tools that were sectioned), recovered from Areas A (n=14), B (n=4), D (n=1), and from surfaces in the site vicinity (n=8), were thin-sectioned to enable hydration age analysis; Table 28 lists the resultant hydration thickness squared measurements.

Two temporally different episodes of obsidian use were suggested by those distributions. The first was associated predominantly with Area B and Area D activity and included the majority of surface-collected obsidian waste flakes. The second episode was associated predominantly with Area A, but was also lightly represented in Area B and on nearby surfaces at the site.

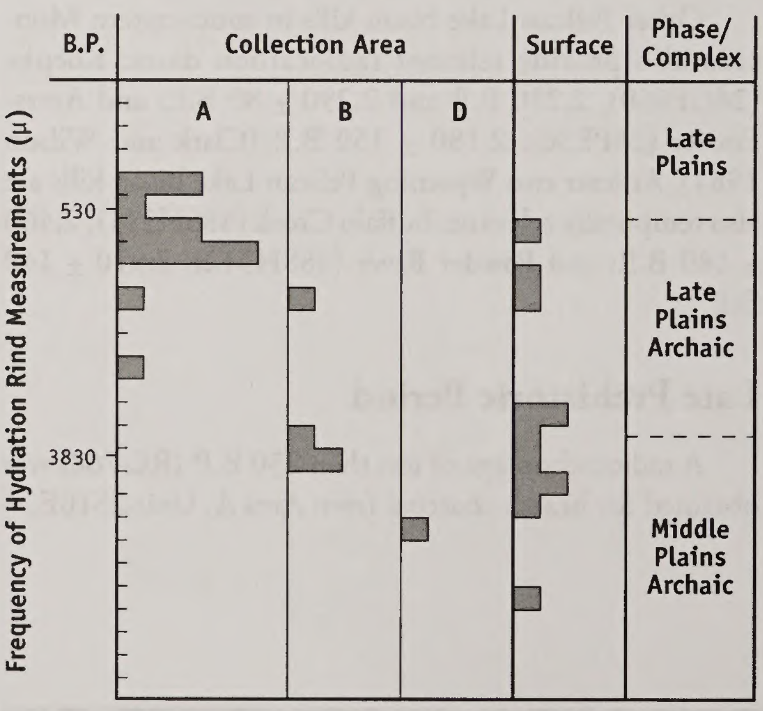



**Figure 43.** Hydration rind thickness for obsidian artifacts arrayed in μ by magnitude relative to time elapsed since human use.

**Table 28.** Obsidian Rind Thickness Squared and Derived Hydration Ages Before Present.

| NWP-12# | Marshall #[1] | Hydration Rind Thickness[2] | Derived Hydration Age B.P.[3] |
|---|---|---|---|
| D2213 | M478 | 2.39 | 1,491 |
| D2214 | M479 | 3.48 | 3,162 |
| D2212 | M477 | 4.07 | 4,250 |
| D2688 | M1003 | 3.94 | 4,052 |
| D2689 | M1004 | 1.48 | 572 |
| D2690 | M1005 | 1.48 | 572 |
| D2691 | M1006 | 4.58 (vague) | 5,477 |
| D2692 | M1007 | 3.94 | 4,052 |
| D2693 | M1008 | 2.54 | 1,684 |
| D2694 | M1009 | 2.16 | 1,218 |
| D2695 | M1010 | 3.01 | 2,366 |
| D2696 | M1011 | 2.19 | 1,252 |
| D2697 | M1012 | 2.56 | 1.711 |
| D2698 | M1013 | 1.72 | 772 |
| D2699 | M1014 | 1.95 | 993 |
| D2700 | M1015 | 1.88 | 923 |
| D2701 | M1016 | 1.54 | 619 |
| D2702 | M1017 | 1.99 | 1,034 |
| D2703 | M1018 | too thin | -- |
| D2704 | M1019 | 2.19 | 1,252 |
| D2705 | M1020 | 2.06 | 1.108 |
| D2706 | M1021 | 2.09 | 1,140 |
| D2707 | M1022 | 3.87 | 3,900 |
| D2708 | M1023 | 3.69 | 3,330 |
| D2709 | M1024 | 3.70 | 3,574 |
| D2710 | M1025 | 4.11 | 4,411 |
| D2711 | M1026 | 1.80 | 846 |
| D2712 | M1027 | 3.92 | 4,001 |
| D2713 | M1028 | 5.16 | 6,907 |

[1]Received at Montana State University (Bozeman) 19 February 1974.

[2]Thickness in μ measured by Nancy Marshall (9831 West Sidehill Road, R.D. 4, North East, PA 16428).

[3]The rate of hydration applied to calculate hydration years Before Present is 3.83 (see Davis 1972).

The Area B mean radiocarbon age of 2,640 B.P., when related to a mean obsidian hydration thickness of 3.83 μ (n=3), yielded a local rate of hydration of 5.6 ± μ squared per 1,000 B.P. for the Pelican Lake phase event.

The Area A mean radiocarbon age of 250 B.P., with a mean obsidian hydration thickness of 2.02 μ (n=12), yielded a local rate of hydration of 16 μ squared per 1,000 B.P. for that late event. This rate appears extreme, but is comparable to a Late Prehistoric period rate derived at the Antonsen bison kill site (24GA559) (Davis and Zeier 1978:229).

Obsidian artifacts from which the hydration rinds were measured, listed in Table 28, were not sourced because sourcing was not necessary in those days, i.e., for hydration age determination.

Three hydration rind measured obsidian Middle Archaic period artifacts are displayed in Figure 44.

Application of the 3.83 rate of hydration to derive hydration ages in Table 28 yielded a series of ages that are displayed more generally in Figure 43. It can be seen that the respective groups of obsidian rind thicknesses tend to replicate the use of obsidian by peoples of the Late Prehistoric period, the Late Plains Archaic period (Pelican Lake), and the Middle Archaic period (Yonkee).

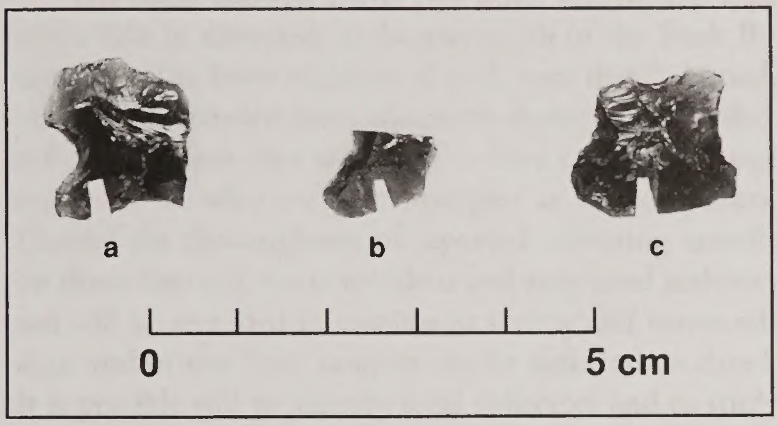



**Figure 44.** Thin-sectioned and hydration-dated Stark Bison Kills obsidian (a-c; see also Figs. 18i and 19b and Table 28 projectile point fragments (a=#D2212, b=#D2213, and c=#D2214).

# Site Significance and Management

*Leslie B. Davis*

The salvage excavation program completed in short time and with minimal institutional and financial support at the Stark Bison Kills, largely as a university instructional field-problem exercise, yielded an informative, if somewhat limited and technically uneven, record of two of three prehistoric locales where bison procurement and processing transpired prehistorically within a small ephemeral drainage in south-central Montana. Artifact collectors had destroyed archaeological deposits in Areas C and D, and partially in Area A. Area B was undisturbed, except for partial loss to erosion. The antiquity, cultural affiliation, and function of these spatially discrete utilized areas were established by this evaluation program.

The Stark site, in its presently diminished condition, is nevertheless important for understanding certain events and cultural dynamics of hunter-gatherers adapted seasonally to the game and mineral resources of the Northwestern Plains Region. Further investigation in Areas A and B would yield additional valuable information, of course. The tentative seasonality determinations would be hardened and population characteristics of the utilized bison could be better defined by further study.

At the time of this writing, erosion of Areas A and C cultural deposits had stabilized. The channel of the ephemeral drainage, which passes between Areas A and C on the south side and Area D on the north side of the wash (Figure 8), has migrated northward up against the sandstone bedrock margin. Some recent lateral cutting had exposed previously disturbed bison bones in Area D; a sample was radiocarbon dated in 1985 (see Table 27) in an attempt to date the Yonkee component that had been destroyed formerly by artifact collectors.

Del Stark showed Davis two other arroyo-trap type bison kills in dissected landscapes north of the Stark Bison Kills. The bone middens of each were deeply buried, but had nevertheless been effectively destroyed by artifact collectors. These sites were said to have contained "large numbers" of what we here interpret as Yonkee points. Despite the thoroughness of reported collecting assaults on those deposits, those middens and associated activities can still be recorded in relation to setting and surroundings, and in situ bone samples can be radiocarbon dated. It is possible still to identify local collectors and to study the removed artifacts. The ownership of the properties on which those sites were located was not know at the time of test excavations at Stark in 1973, and no followup work was attempted. Stark is but one of several damaged bison kill sites in that area that can still yield complex information about prehistoric human behavior.

The most economical management option for this partially intact site is to take no further action at the site, other than possibly identifying it as being in federal ownership and thereby protected by law against unauthorized intrusions. No indication of post-excavation vandalism was observed during a site visit in October 1984 by Davis and Ottersberg. The lessee was aware of and was interested in the site as a valued cultural heritage manifestation that should be protected against further destruction. It is recommended that the full extent of nearby federal and state properties be surveyed for similar-age archaeological deposits, particularly Yonkee bison kills.

In conclusion, since the Stark Bison Kills can yield information important for understanding local and regional prehistory, the site is eligible for registration on the National Register of Historic Places.

## Acknowledgments

This account is dedicated to the memory of Mr. J. A. (Del) Stark of Roundup, Montana, whose unique world-view and sense of history, poetic wit, and irrepressibly cheerful hospitality made fieldwork (excavating in concrete-like gumbo under a sweltering, unforgiving summer sun) not only tolerable on occasion, but downright enjoyable.

The MSU Endowment and Research Foundation (ERF) funded radiocarbon and obsidian hydration dating. The late Roy E. Huffman, Professor Emeritus of Agricultural Economics and former ERF Director and Vice President for Research, supported archaeological research by Davis, for which Davis is grateful.

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Joseph L. Cramer (Denver) loaned photographs, corresponded, and shared his experiences during visits by himself and Oscar Lewis to the Stark Bison Kills in the 1950s.

Davis thanks Becky (Dasinger) Kallevig of Sidney, MT for her service as field supervisor and MSU students (Ardyce Jensen, Bill Spencer, Jean Thorson, Edwin Mohler, and Joe Shutak) who participated in the excavations, and O. M. Mabry for volunteer assistance. Edwin Mohler is singled out for his mapping contributions and his memorable, although unbidden (and sometimes peculiar) photographic contributions, and the fact that he much later (2008) helped Davis to fathom old records and other manuscript anomalies. Steve Aaberg described and analyzed the Stark site artifacts gratis, as did Ann Johnson the ceramics. Diane Fuhrman wordprocessed several versions of this manuscript.

Finally, Davis thanks the George Raths family for their hospitality and for generously backfilling the excavation units.

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## Appendix 1. Morphology* of Sediments in the Area B Profile.

| Horizon | | | Munsell Color | | Textural Class | Structure | Consistence | | Effervescence | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| # | Name | Depth (cm) | Dry | Moist | | | Dry | Wet | | |
| 1 | A-C | 0- 7 | 2.5Y 6/3 | 2.5Y 5/3 | l | 1-2fGR | lo+sh | ss ps | ev | m.f. roots |
| 2 | C1 | 7- 15 | 2.5Y 7/3 | 2.5Y 5/3 | l | 1-2m+fSBK | h | so ps | es | c.f. roots |
| 3 | C2 | 15- 30 | 2.5Y 7/3 | 2.5Y 6/3 | l | 2m+fSBK | vh | ss p | ev | f.f. roots |
| 4 | C3 | 30- 50 | 2.5Y 7/3 | 2.5Y 6/3 | fsl | 2m+fSBK | h | so ps | es | f.f. roots |
| 5 | C4 | 50- 55+ | 2.5Y 6/2 | 2.5Y 5/3 | sil | l-2fSBK | sh | so ps | e-es | f.f. roots |
| 6 | C5 | 55- 65 | 2.5Y 7/4 | 2.5Y 5/4 | l | M | sh | s ps | es | -- |
| 7 | AIIB | 65- 70 | 2.5Y 6/3 | 2.5Y 4/2 | sil | 2mSBK | sh | s ps | es | Midden, few lime seams |
| 8 | C6 | 70- 80 | 2.5Y 7/3 | 2.5Y 6/3 | sil | 1-2fABK | sh | ss po | ev | bone frag. |
| 9 | C7 | 80-110 | 2.5Y 7/2 | 2.5Y 6/3 | sicl | M | h | sv p | ev | common lime threads + seams |
| 10 | C8 | 110-130 | 2.5Y 6/2 | 2.5Y 6/2 | l-fsl | 1mSBK | sh | so po | ev | few charcoal fragments |
| 11 | IIC9 | 130-150 | 2.5Y 7/2 | 2.5Y 6/2 | (gr)scl | SG | lo | s p | ev | 25-40% ground fine gravels |
| 12 | IIIA12b | 150-155 | 2.5Y 6/3 3/2 | 2.5Y 4/2 | sl-scl | 1m+fSBK | sh | ss po | ev | common charcoal fragments |
| 13 | IVC10 | 155-180 | 2.5Y 7/3 | 2.5Y 6/2 | hl | 1m+fABK | h | ss p | ev | -- |

*Morphology Codes
Texture: c=clay; l=loam, si=silt; s=sand; f=fine; lt=light; h=heavy
Combine as follows: ls=loamy sand; sil=silt loam, gr=gravelly; vgr=very gravelly; co=cobbley; st=stump
Structure – grade: 1=weak; 2=moderate; 3=strong
size: f=fine; m=medium; c=course
type: ABK=angular blocky; GR=granular; M=massive; PR=prismatic; Pl=platy, SGK=subangular blocky; SG=single grain; bt=breaking to

Consistence: so=non sticky; ss=slightly sticky; s=sticky; sv=very sticky; po=unplastic; ps=slightly plastic; p=plastic; pv=very plastic
Effervescence: eo=non-effervescent; e=slight effervescence; es=strong effervescence; ev=violent effervescence boundary: a=abrupt, c=clear; g=gradual, i=irregular; s=smooth, w=wavy

# Appendix 2. Characterization of Soils and Sediments.

| Horizon # | Depth (cm) | Organic Matter (%) | $CaCO^3$ % Equivalence | Bray Phosphorus (%) | Soil Textural Class* | Mechanical Analysis | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | % Sand | % Silt | % Clay |
| 1 | 0- 7 | 1.47 | 46.32 | 23.32 | L | 39 | 35 | 26 |
| 2 | 7- 15 | 1.96 | 46.84 | 19.29 | SCL | 53 | 23 | 24 |
| 3 | 15- 30 | 1.08 | 27.50 | 17.70 | CL | 33 | 37 | 30 |
| 4 | 30- 50 | 0.90 | 13.75 | 20.32 | CL | 37 | 35 | 28 |
| 5 | 50- 55 | 0.96 | 13.99 | 28.68 | SiL | 33 | 57 | 10 |
| 6 | 55- 65 | 0.2 | 8.7 | 19.78 | SiL | 38 | 52 | 10 |
| 7 | 65- 70 | 0.96 | 10.4 | 19.45 | SiL | 29 | 61 | 10 |
| 8 | 70- 80 | 0.25 | 7.7 | 20.82 | SiL | 35 | 57 | 8 |
| 9 | 80-110 | 0.45 | 7.4 | 18.34 | CL | 37 | 33 | 30 |
| 10 | 110-130 | 1.21 | 4.9 | 18.61 | L | 49 | 30 | 21 |
| 11 | 130-150 | 0.56 | 4.9 | 25.39 | SiL | 22 | 69 | 9 |
| 12 | 150-155 | 6.01 | 3.0 | 17.32 | CL | 45 | 24 | 31 |
| 13 | 155-180 | 0.14 | 4.1 | 21.28 | CL | 39 | 31 | 30 |

*CL = clay loam; L = loam; SiL = silt loam; SCL = sandy clay loam

# PRECONTACT ARCHAEOLOGY AND PREHISTORY of the Central Montana High Plains

## Middle and Late Prehistoric Human Activities and Events at Cultural Venues in Badlands, Riverine, and Plateau Settings

Brief Field operations in the 1970s were dedicated by Montana State University-based archaeologists to developing records by which to understand certain archaeological deposits in central Montana, which, in the first case, had been partly or entirely exposed by surface-weathering processes, in the second, were found still buried and sealed in floodplain sediments, and the third had been sealed in place by slopewash. Erosion and destruction by artifact collectors continually put these fragile residues of past human lifeways at risk of obliteration. By adopting a historic preservation attitude and taking a proactive posture, these widely scattered, fragile remains can be protected and their legacy values conserved, in the public interest through concerted investigation.

The work reported here was stimulated by such circumstances. Enabling financial support was provided by the Bureau of Land Management and the Federal Bentonite Division of Aurora Metal Company. Private landowners and lessees of public land cooperated by allowing access to the cultural properties of interest, and generously backfilled excavated areas at the close of field operations.

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Honors include the 2008 Montana Historical Society Trustees' Award for contributions to Montana history; the Charles and Nora Wiley Award for Meritorious Research (MSU Foundation: 1995); the 1992 National Award for Excellence in recognition for an outstanding contribution to **Windows On The Past** (U.S.D.A. Forest Service); the 1981 Historic Preservation Review Board Commendation in recognition for skill and energy in presenting the values and processes of archaeology to professional and lay publics; and the 2003 Historic Preservation Board Award for his ongoing commitment to historic preservation in the State of Montana.

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